PROGRESS REPORT NUMBER 21

FOR

OCTOBER 1, 1962 TO NOVEMBER 30, 1962

DESIGN, DEVELOPMENT AND FABRICATION OF BAROSWITCH, REMOTE XM-10; BAROSWITCH, PRESET XM-11; AND CONTROL BAROSWITCH SETTING: XT-4126

CONTRACT NO. DA-36-034-ORD-2890-RD

FOR

PICATINNY ARSENAL, DOVER, NEW JERSEY
ATTN: FELTMAN RESEARCH AND ENGINEERING LAB
ORDBB - TV4 - PROJECT - TN2 - 8109

PREPARED BY:

THE BENDIX CORPORATION
FRIEZ INSTRUMENT DIVISION
BALTIMORE 4, MARYLAND

DECEMBER 7, 1962

Bendix-Friez

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REF:
FR-92167
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Period Covered: October 1, 1962 to November 30, 1962

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Contract No. DA-36-034-ORD-2890-RD

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PROGRESS REPORT NUMBER 21

DEVELOPMENT OF:

BAROSWITCH, XM-10
BAROSWITCH, XM-11
SETTER, XT-4126

I. INTRODUCTION

Included in this report is a discussion of the work done on this project during the period from October 1, 1962 through November 30, 1962. It includes the status of development of each of the two baroswitches and XT-4126 Control Setter.

Also included in this report is a schedule for the work to be done during the period which follows this report period.

II. REPORT OF PROJECT ACTIVITIES DURING REPORT PERIOD

A. Baroswitch, XM-10

The investigation of contact materials recommended by H. A. Wilson Division, Engelhard Industries, Inc., as outlined in Progress Report Number 20, has now been completed. An evaluation report of the H. A. Wilson contact materials has been prepared and is included as Appendix "1" of this report. The report bears out the fact that the program is now capable of proceeding with a high degree of confidence in baroswitch capabilities. For convenience of comparison with previous results, a report on the tungsten contact material, described in Progress Report Number 20, is included as Appendix "2" of this report.

A selection of the 91% platinum, 9% tungsten alloy was made for the contact material of all future XM-10 baroswitches. This selection was based on the following:

1. The 74% W - 26% Re showed the poorest operating capabilities and was therefore eliminated.

2. The polarized configuration operating characteristics almost equaled the 91% Pt - 9% W contacts, however, was eliminated due to the anticipated difficulties of maintaining contact polarity. As stated in the test report (Appendix "1"), it is absolutely necessary that the 91% Pt - 9% W contact be the anode and the 74% W - 26% Re be the cathode.

It should be noted that a number of capsules developed leaks after a large number of setting cycles. This problem had not been present earlier in the program since no group of baroswitches had been subjected to such a large number of setting cycles. It was established that the capsule leaks occurred in the braze material between the capsule plate and joining bellows. Handy and Harman were consulted and suggested a new braze alloy, Lithobraze BT. This alloy offers an increase of joint strength, by a minimum factor of 3, while providing a better wetting action. Nine plate and bellows assemblies were made and tested. One assembly developed a leak at 65 cycles due to a defective bellows. This leak did not occur in the braze but in the bellows itself. The remaining assemblies were subjected to three hundred setting cycles and none developed any leaks. Picatinny Arsenal was advised of the test results and the drawing is in the process of being changed to the Lithobraze BT. All baroswitches delivered in the future shall have plate and bellows assemblies fabricated with Lithobraze BT brazing alloy.

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All baroswitches starting with S/N 0068 will be of the XM-10 - XM-18 design. Since this design does not contain a linearizing mechanism to correct for the inherent error of the capsule assembly, it will be necessary to incorporate a padding resistor similar to that used on the XM-18 baroswitch. The padding resistor has very high resistance (Ca. 500K Ohms) and is connected between one end of the potentiometer and the potentiometer wiper. This resistor then adds more correction at one end of the setting range than it does at the other end, which has the effect of strengthening the error curve and at the same time increases the error at the end of the setting range. The error at the end of the setting range is then corrected by means of the hinge mechanism in the element assembly while still maintaining the correction characteristics obtained by the padding resistor. The value of the padding resistors used to date range from 250K to 560K. The initial capsule error, in either plus or minus direction, determines which end of the potentiometer the resistor is attached. The addition of the padding resistor has been discussed with Mr. Jack Woods, Project Officer, Picatinny Arsenal, and will be added to the drawings upon official acceptance.

At the present time three XM-10 baroswitches have been assembled and are in the process of final testing. All three baroswitches differ from previously delivered XM-10 baroswitches as follows:

a. The latest design (XM-10 - XM-18)

b. Cross contacts of 91% Pt - 9% W alloy

c. Plate and bellows assemblies brazed with lithobraze BT alloy

d. Contain padding resistors

No difficulties have been encountered to date with these three XM-10 baroswitches and none is anticipated. It is expected that a total of five XM-10 baroswitches will be shipped during the month of December.

The special vibration test using Robinson Aviation isolators, which was requested by Picatinny Arsenal, has now been completed. A complete report is included as Appendix "3" of this report showing all test data and conclusions.

B. Barosetter, XT-4126A

A total of five XT-4126A barosetters have been delivered, leaving three to be delivered. All three of the remaining XT-4126A barosetters are now complete with the exception of the painting of the front panels and carrying cases. It is anticipated that all three barosetters will be shipped during the month of January.

Three complete sets of revised drawings have been delivered which reflect all of the latest revisions and are to replace previous drawings at Picatinny Arsenal.

Work has been initiated on the writing of a Qualification Test Program and will be submitted for approval prior to conducting the test.

C. Summary

It now appears that the question of the vibration isolator is the only remaining major problem existing in the XM-10 baroswitch. The vibration isolator problem should be resolved very shortly since all of the required testing has been completed and the test results have been submitted to Picatinny Arsenal.

No additional XM-10 problems are anticipated and regular deliveries should begin about the end of December.

D. Man-Hours Expended During Report Period

During this report period, there have been expended approximately 2320 hours on Engineering and 1430 hours on Fabrication.

III. PROJECT PLANNING SCHEDULE FOR THE NEXT REPORT PERIOD

A. Baroswitch, XM-10

1. Assemble and test XM-10 baroswitches for delivery.
2. Conduct shock test on XM-10 baroswitch using special Robinson Aviation isolators.
3. Resume writing of Mandatory Process.

B. Barosetter, XT-4126A

1. Complete and deliver remaining three XT-4126A barosetters.

2. Complete writing of Qualification Testing Program.

Prepared By: W. J. Hughes
W. J. Hughes
Project Engineer

Approved By: F. K. Davey
F. K. Davey
Section Head
Special Products Group

APPENDIX "1"

APPENDIX 1

REPORT ON EVALUATION OF H. A. WILSON CONTACT MATERIALS

INTRODUCTION:

Upon recommendation of Dr. Mooradian of Engelhard Industries, two new materials, a 75% tungsten - 25% rhenium alloy (W-Re), and 91% platinum - 9% tungsten alloy with .25% thorium oxide added (Pt-W), were tried in the cross-contact configuration of the XM-10 and XM-18 baroswitches to improve loop resistance and repeatability characteristics.

PROCEDURES:

Two baroswitches of each of the following configurations were assembled for testing:

1. Units 8 and 11 had the W-Re contacts.

2. Units 9B and 12 had the Pt-W contacts.

3. On units 10 and 13 the Pt-W contact was used as the anode and the W-Re contact was used as the cathode. This is referred to as the polarized configuration.

ASSEMBLY DOCUMENTATION:

1. The contacts, as received, were .040" diameter wire .100" long. The tungsten wire had been cleaned and electropolished, while the platinum wire was cleaned only.

2. The terminal posts were V-notched so that the working surface of the contact was mounted .156" ± .001" from the face of the diaphragm. All contacts were brazed with the resistance brazing iron.

3. The contact-diaphragm assemblies were cleaned as follows: The diaphragm and contact were scrubbed with Ajax and hot water. Then they were ultrasonic-cleaned in a hydrocloric acid solution. Bright-Boy was used to clean the diaphragm lips, and each part was blown off with filtered air.

The tungsten contacts were polished with 4/0 emery paper. Then both contact types were polished with yellow rouge, using a hard wheel and then a soft wheel. The rouge was cleaned from the contact stems and flanges using reagent trichlorethylene. Following this, the assemblies were ultrasonically cleaned for six minutes in a trichlorethylene solution.

At this point, the tungsten contacts were electro-polished to provide a mirror-like, check-free surface. Then both types of contact-diaphragm assemblies were ultrasonic-cleaned in an alconox-ammonia-water solution. Upon removal of the parts from the ultrasonic bath, they were immediately rinsed in hot water so as to prevent stains. Excess water was blown off with filtered air, and the parts were placed in a drier at 160°F.

Operation No. A130 of the baroswitch production process followed:

Five minutes ultrasonic cleaning in trichlorethylene.

Blow dry with filtered air.

Two minutes ultrasonic cleaning in detergent solution*.

Rinse in distilled water.

Two minutes ultrasonic cleaning in distilled water.

Blow dry with filtered air.

Two minutes ultrasonic cleaning in isopropyl alcohol.

Blow dry with filtered air.

*Detergent solution: 80% isopropyl alcohol, 20% distilled water, .2% Renex 690 (by volume), .05% Span 80 (by volume).

Operation A70, a white room operation, was the last step before welding the diaphragms to the plate and bellows assembly.

Three minutes ultrasonic cleaning in trichlor-ethylene.

Blow dry with nitrogen.

Three minutes ultrasonic cleaning in previously mentioned detergent solution, rince in distilled water.

Three minutes ultrasonic cleaning in distilled water.

Blow dry with nitrogen.

Three minutes ultrasonic cleaning in isopropyl alcohol.

Blow dry with nitrogen.

The parts were dried for 20 minutes at 240°F in a vacuum oven evacuated to 29 inches of mercury or better.

The parts were now ready for welding to the plate and bellows assembly.

4. Plate and bellows assembly cleaning process: After brazing the bellows and the exhaust tube to the capsule plates (an operation which is still undergoing development), the assembly receives operation A30 as follows:

Ultrasonic cleaning in the following solutions:

5% Hydrochloric acid for two minutes

Distilled water for three minutes.

5% Sodium bicarbonate (water) for two minutes

Distilled water for three minutes

Excess water is blown off with filtered air, and the parts are placed in a drier at 180°F.

Next the parts are checked with the Veeco Leak Test Fixture. The welding lands are machined, and the crimps on the exhaust tubes are machined off to allow proper cleaning of the tube bores in subsequent operations.

Operation A80 of the Baroswitch process follows: An ultrasonic cleaning in hot water for two minutes, followed by a thorough rinse in hot water, and filtered air drying. Then the following series:

Ultrasonic clean for two minutes in reagent trichlorethylene, blown dry with filtered air, ultrasonic clean for two minutes in the following detergent solution: 80% isopropyl alcohol, 20% distilled water, .2% Renex 690, .05% Span 80. A distilled water rinse, two minutes ultrasonic cleaning in distilled water, blown dry with filtered air, two minutes ultrasonic cleaning in isopropyl alcohol, blown dry with filtered air.

Finally operation A-70, previously described, is applied.

The parts are now ready for diaphragm welding.

5. Outgassing, purging and backfilling procedure (following welding operation): baroswitch production procedure #14 was used on these baroswitches. The three operations were done on the Veeco US-9 outgassing manifold. All capsules were done at the same time.

   a. The units were outgassed for one and one-half hours at 370°F while maintaining a vacuum of 10 microns or less.

   b. The units were backfilled to 2 PSIG, left idle for ten minutes, and evacuated to 10 microns or less.

   c. Step (b) was repeated twice. This completed the three purge cycles.

   d. The units were cooled to room temperature while backfilled with 2 PSIG of nitrogen. Then the units were evacuated to 10 microns or less, and backfilled to 35 mbs of nitrogen. The exhaust tubes were crimped off, completing the backfilling procedure.

6. Hinge post length was 1.007" - .004", as per print. Some of the posts were shortened to compensate for shallow bores in the hinge post caps, but the effective hinge post length remained the same. The hinge post angle (number of degrees the hinge post is rotated from a line through the centers of the two hinge posts) varied considerably from element to element. A change in the hinge post angle moves the fulcrum from which the element plates pivot when driven by the gear train, thereby aiding in the rough ranging of the elements.

   No shims were required in obtaining parallel plates at mid-range (546.6 mb's).

7. Following the test series, the setter used was calibrated and found to be well within required tolerances.

8. The number of setting cycles performed by each gear train is estimated at 1000 cycles per gear train.

DESCRIPTION OF TESTS:

A. Testing without contact scrubbing:

   1. A full range room temperature test was conducted making altitude settings from both increasing altitude direction and decreasing altitude direction. Contacts were opened during altitude setting changes. The operating point of each element was established noting the shift of operating point. The maximum overpressure encountered by any element did not exceed 15 millibars more than the pressure of the operating point.

   2. At an altitude of 30,000 feet, 50 dives were taken, recording each 10 dives. The altitude setting remained at 30,000 feet during the loop resistance testing and the maximum overpressure seen by any element did not exceed by more than 15 millibars the pressure of the operating point.

   3. Step 2 was repeated with an altitude setting of 25,000 feet. The contacts remained open during the change from 30,000 feet to 25,000 feet.

   4. Three complete temperature tests including loop resistance readings were taken. Contacts were open during all altitude setting changes and maximum overpressure encountered by any element did not exceed 15 millibars more than the operating point pressure.

B. <u>Testing with Contact Scrubbing:</u>

1. With a manifold pressure of 1060 millibars during all setting operations and temperature test procedures, the following was conducted:

   a. Ten scrubs (altitude setting cycles).

   b. Room temperature test for repeatability and loop resistance.

   c. 25 Scrubs.

   d. Room temperature test for repeatability and loop resistance.

   e. 50 Scrubs.

   f. A complete temperature test repeatability and loop resistance.

   g. 100 Scrubs.

   h. Room temperature test for repeatability and loop resistance.

   i. 100 Scrubs.

   j. Room temperature test for repeatability and loop resistance.

2. The loop resistance of each element was determined at each temperature in the above procedure.

C. At the conclusion of baroswitch testing the capsules on all switches were cut open so that the contacts could be examined and photographed.

<u>Tests Performed on Each Unit:</u>

1. Units 8 (W-Re), 9B (Pt-W) and 10 (polarized) were subjected to the tests in category A.

2. All six units were subjected to the tests in categories B and C.

RESULTS AND DISCUSSIONS:

Bar graphs showing distribution of repeatability and loop resistance data points for each test are appended. Table I, showing representative operating point shift, is also appended.

The tests prescribed in Part A, sections 2 and 3, (50 dives at 30,000 feet and at 25,000 feet), were to see if deformation of the contacts while diving at 30,000 feet would affect repeatability or loop resistance at 25,000 feet. Repeatability was not affected, although a slight (6%) increase in average loop resistance readings was noted.

The bar graphs show results as follows. For "B" type (scrubbing) tests, the tungsten contacts (units 8 and 11) have 87% of their repeatability points equal to or less than 0.5 mbs. The platinum contacts (units 9B and 12) have 96% of their data points equal to or less than 0.5 mbs, and the polarized contacts (units 10 and 13) show 94% of their data points equal to or less than this figure.

Loop resistance results for "B" tests are summarized below:

		Percent of Data Points Equal to or Less Than:	
Type of Contact	Unit Numbers	0.2 Ohms	0.4 Ohms
Tungsten	8 and 11	97%	100%
Platinum	9B and 12	96.5%	100%
Polarized	10 and 13	95%	100%

The large number of high loop resistance readings on Units No. 8 and 10, Test A, was due to faulty test cables which were replaced, resulting in low resistance readings for the remainder of the test runs.

Table I, sample operating point shifts, shows that operating point shift is not excessive during cycling. Shift would be due to wearing of friction surfaces on the baroswitch, and other factors.

Figures 1, 2 and 3 show representative samplings of the three contact configurations after scrubbing tests.

A P P E N D I X "A"

TABLE I

OPERATING POINT SHIFT DURING "B" TYPE TESTS

NOTE: Values listed are deviations from mean in millibars.

Unit No. 8 (Tungsten Contacts)

Element No. 1

Altitude Setting (ft.)	Mean Set Point (Mb's)	No. of Scrubs: 10	37	95	197	305
1,000	973.5	+0.7	+0.3	-0.3	-1.2	+0.5
8,000	747.2	+1.9	+0.6	-2.2	-0.3	-0.1
15,000	568.3	+0.9	0	-0.8	-0.7	+0.4
25,000	372.8	+0.6	+0.4	-0.3	-1.1	+0.5
40,000	182.6	+1.0	+1.0	-0.5	-1.7	0
50,000	112.0	+0.3	+0.7	+0.1	-2.2	+1.0

Unit No. 9B (Platinum Contacts)

Element No. 1

Altitude Setting (ft.)	Mean Set Point (Mb's)	No. of Scrubs: 10	37	95	197	305
1,000	979.7	+1.9	+0.1	-0.9	+0.3	-0.5
8,000	756.5	+0.5	-1.4	+0.8	-0.5	+0.3
15,000	579.7	-0.7	+3.0	-1.6	+3.6	-1.1
25,000	376.8	-1.3	+3.2	-0.3	+2.2	-1.1
40,000	182.8	-1.0	+2.3	-1.0	+0.6	+0.2
50,000	116.2	-0.9	+1.5	-1.0	+1.4	-0.1

Unit No. 9B (Platinum Contacts)
- continued -

Element No. 2

Altitude Setting (ft.)	Mean Set Point (Mb's)	No. of Scrubs 10	37	95	197	305
1,000	976.4	+0.6	+0.6	-0.1	-0.2	-1.6
8,000	756.0	+1.0	+1.0	+0.4	-1.2	-1.5
15,000	577.4	+0.6	+0.9	+1.1	-0.6	-1.9
25,000	378.4	+0.4	+1.1	+1.1	-1.0	-1.4
40,000	183.6	+0.4	+1.2	+0.8	-1.0	-1.0
50,000	114.3	+0.5	+0.8	+1.3	-1.4	-1.0

Element No. 3

Altitude Setting (ft.)	Mean Set Point (Mb's)	10	37	95	197	305
1,000	974.5	+1.8	+0.7	-1.8	+0.7	-1.1
8,000	739.4	+1.2	+2.1	0	-2.0	-1.0
15,000	549.9	+2.1	+1.7	-0.5	-2.8	-2.3
25,000	345.0	+1.3	+0.4	-0.9	-0.8	0
40,000	156.3	+1.8	0	-1.8	+0.9	-1.2
50,000	119.8	+1.4	+0.4	-1.7	+1.0	-0.2

Unit No. 9B (Platinum Contacts)
- continued -

Element No. 4

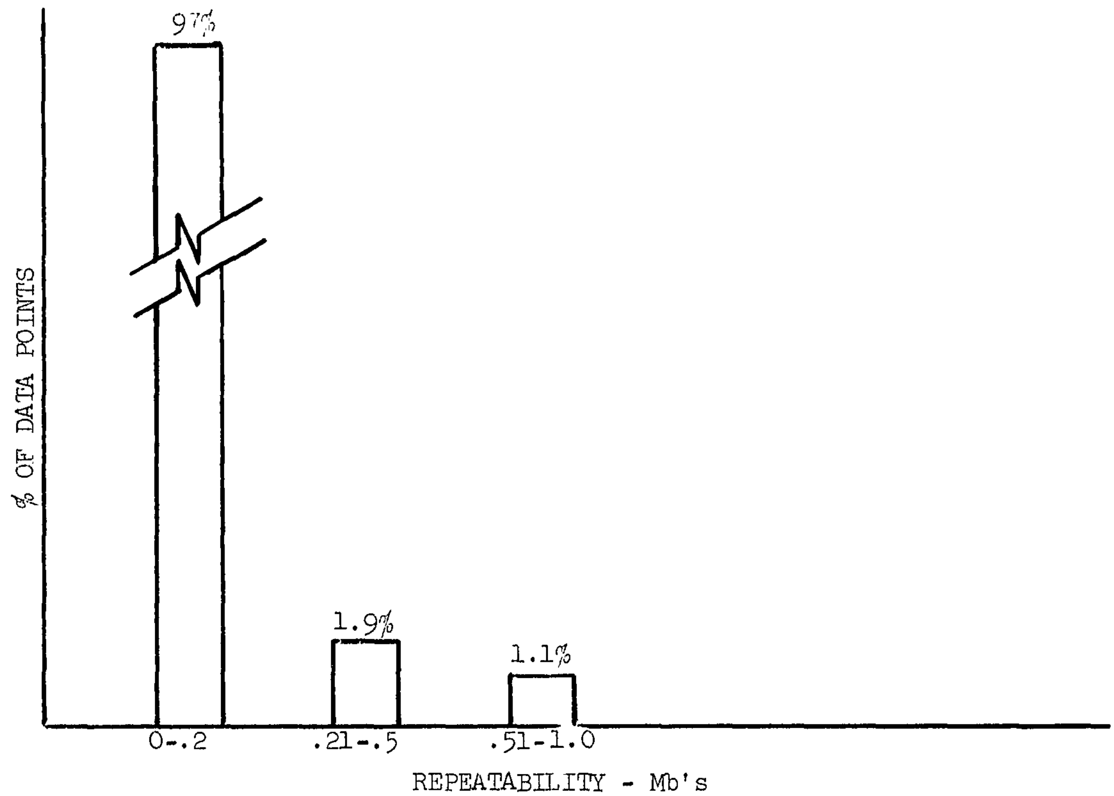
Altitude Setting (ft.)	Mean Set Point (Mb's)	No. of Scrubs 10	37	95	197	305
1,000	976.2	+0.1	0	+0.5	+0.8	+0.3
8,000	749.4	+0.2	+1.4	+0.7	+1.0	-5.2
15,000	569.0	+1.1	+0.3	+1.6	+0.6	-6.3
25,000	370.8	+0.5	+1.2	+1.3	+2.2	-5.3
40,000	178.9	+0.9	-0.4	+0.6	+2.1	-4.8
50,000	108.7	+1.1	-0.9	+0.9	+2.7	-5.2

Unit No. 10 (Polarized Contacts)

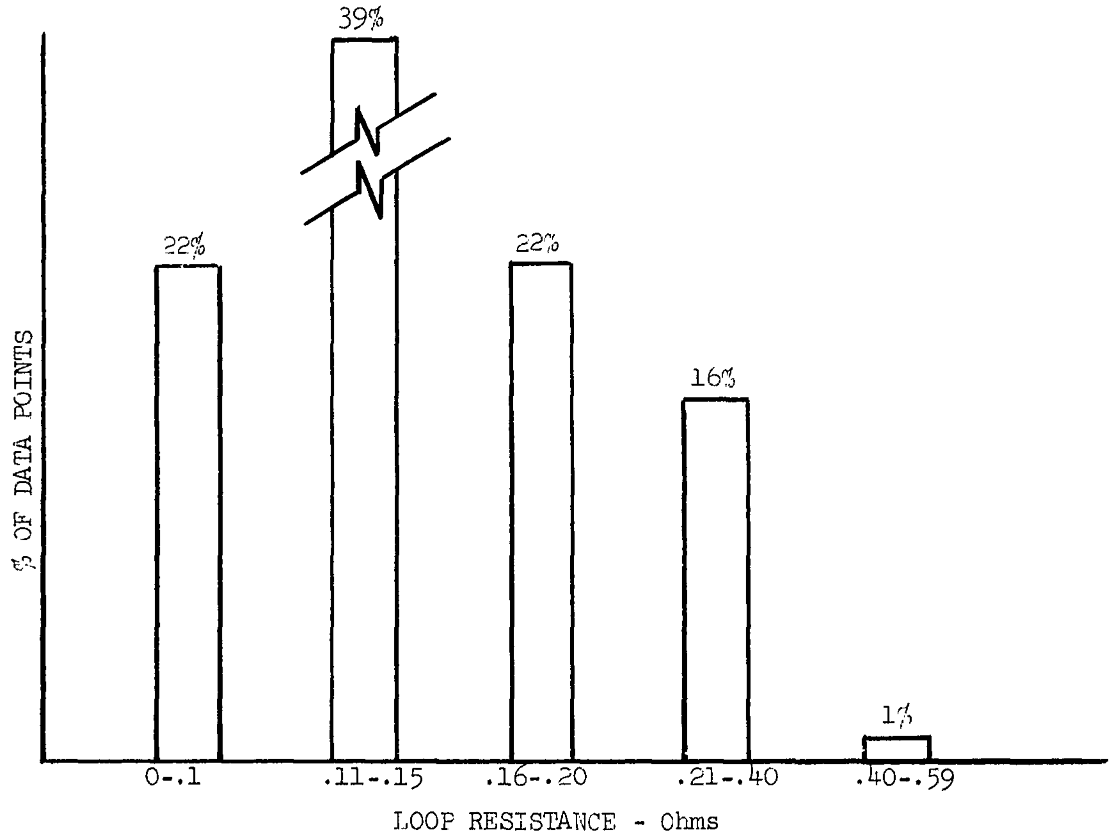
Element No. 1

Altitude Setting (ft.)	Mean Set Point (Mb's)	No. of Scrubs 10	37	95	197	305
1,000	975.7	-0.1	-2.1	+0.3	+0.7	+1.4
8,000	746.1	0	-0.1	+0.9	+0.1	-1.0
15,000	562.5	+0.1	+0.3	+0.3	-0.2	-0.7
25,000	362.7	-0.7	-1.5	+0.3	+0.8	+1.0
40,000	174.4	-0.8	-1.4	-1.0	+1.2	+1.8
50,000	112.1	-0.1	-0.9	-1.0	+1.3	+0.5

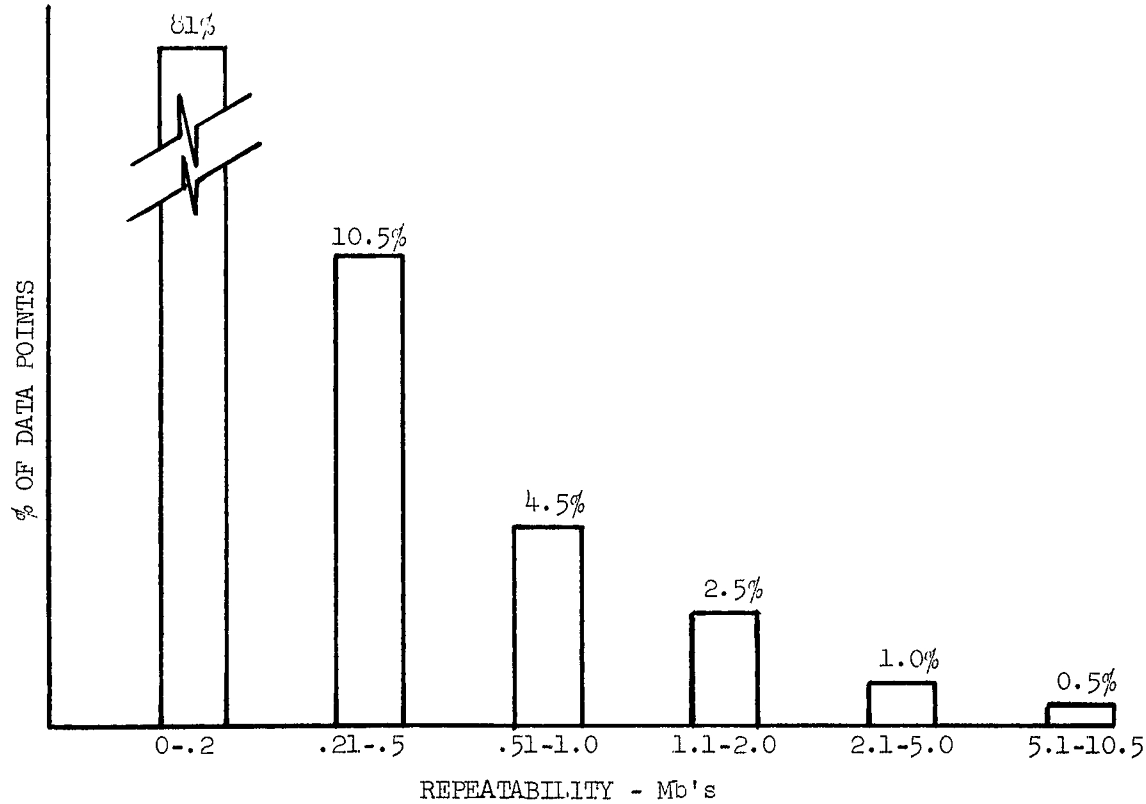
APPENDIX "B"



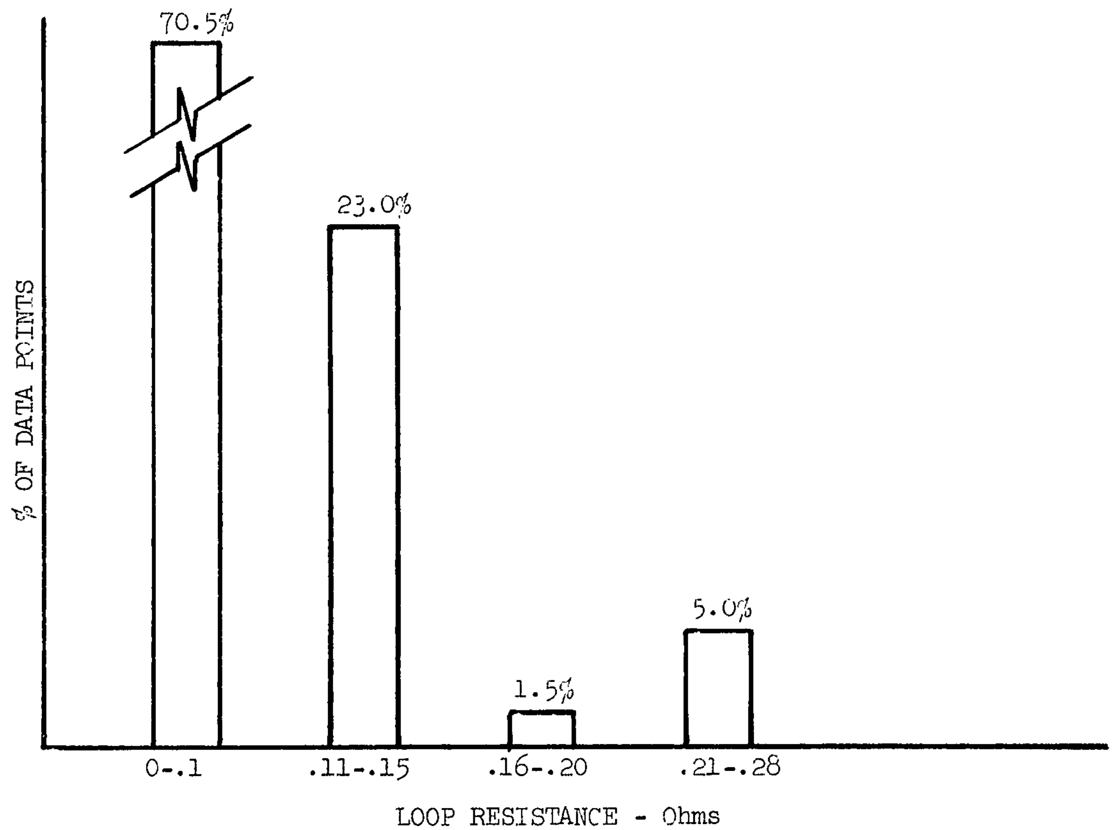
NOTE: Element #2 Leaked After 172 Scrubs. New contact resistance connections added after third Room Temperature run



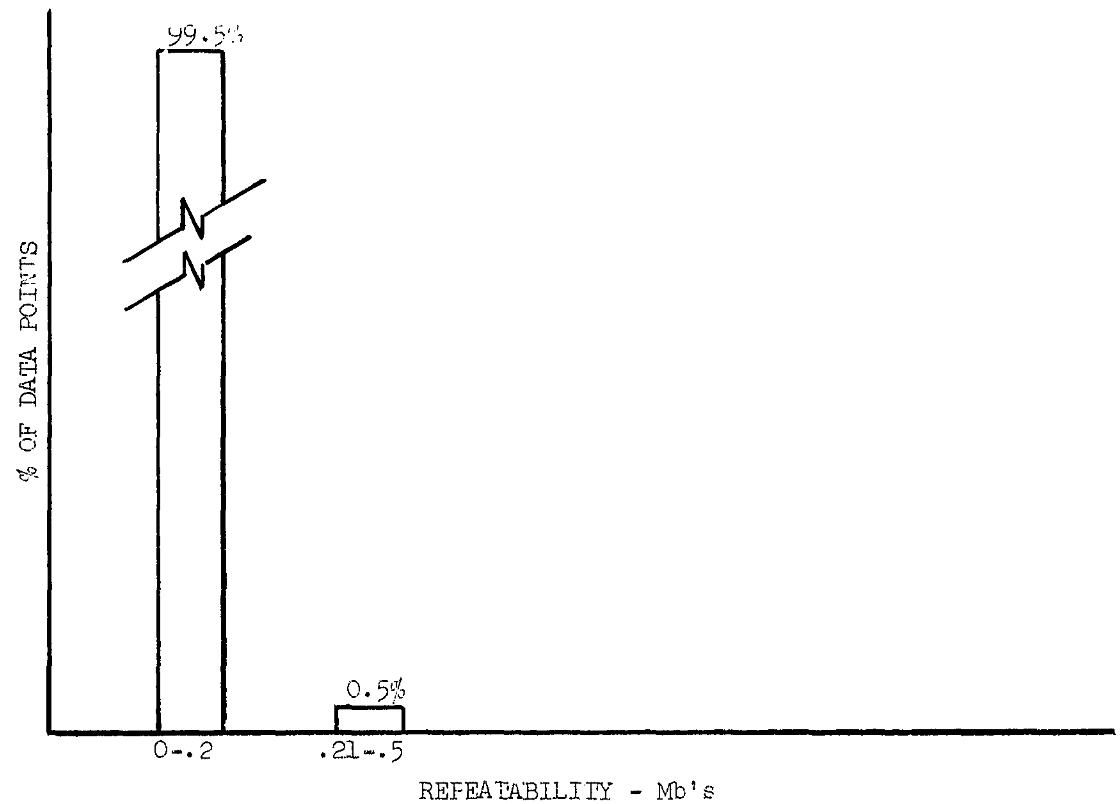
Unit #6 (Tungsten Contacts) Test A



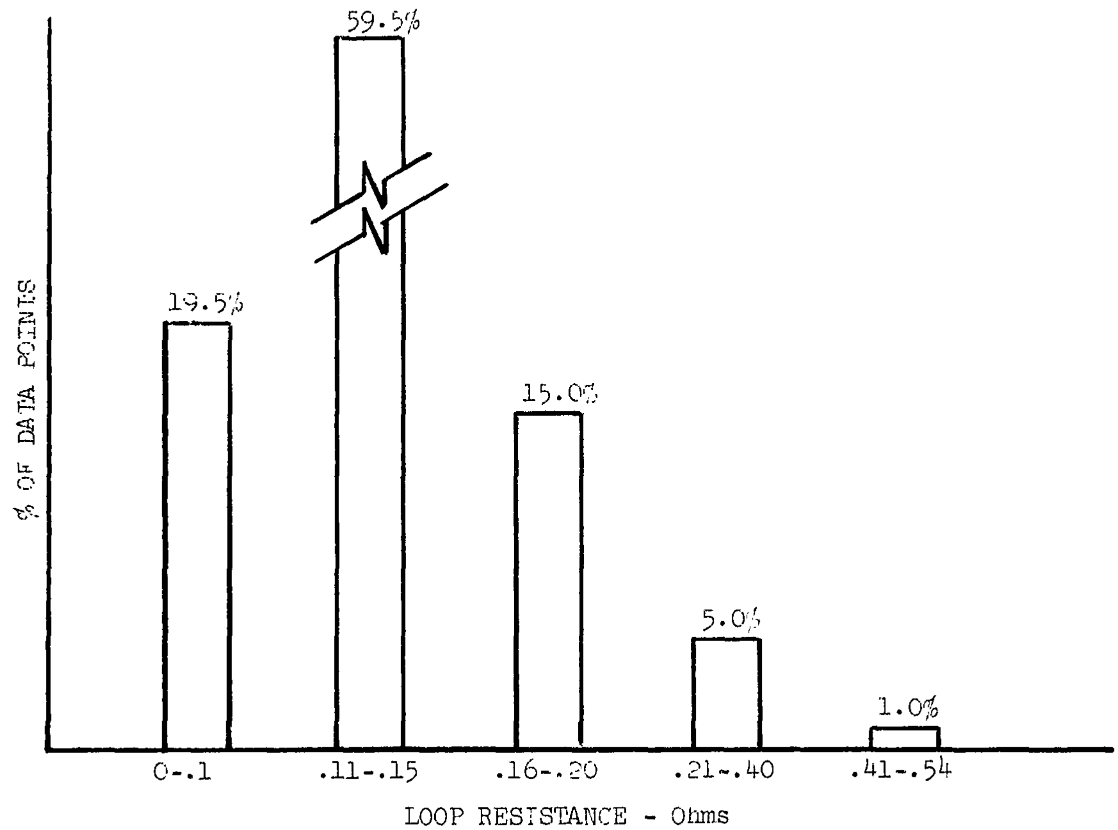
NOTE: Element #2 Leaked After 172 Scrubs



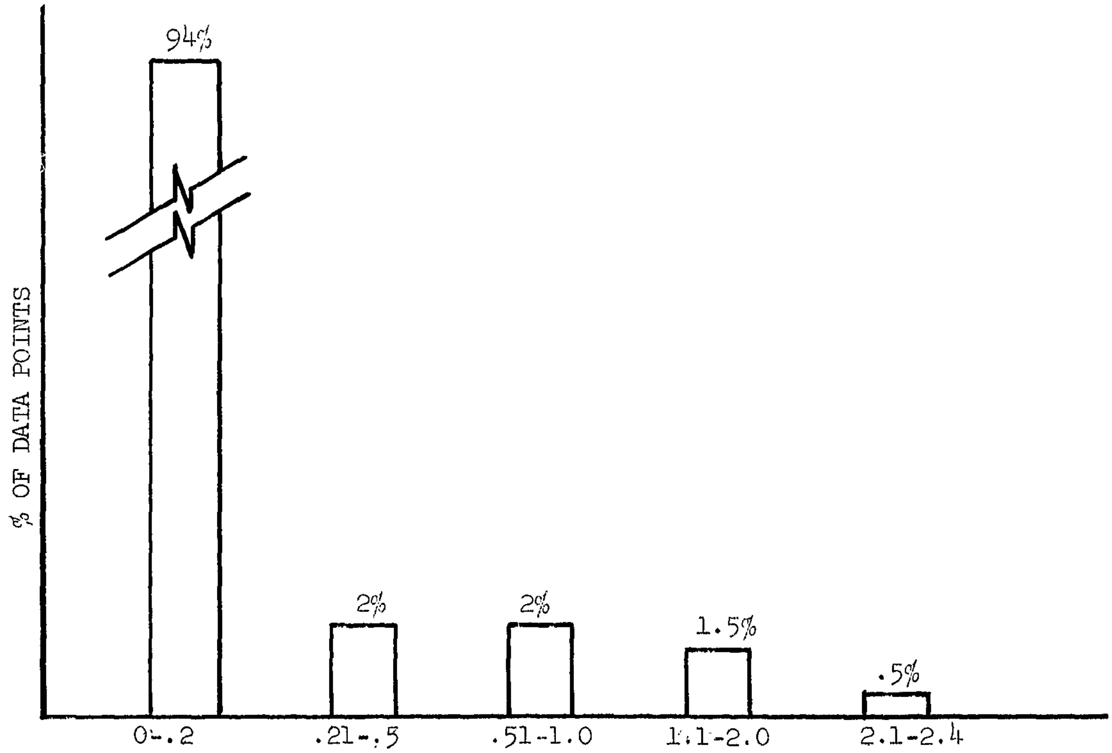
Unit #8 (Tungsten Contacts) Test B



NOTE: Element #2 Leaked After 172 Scrubs

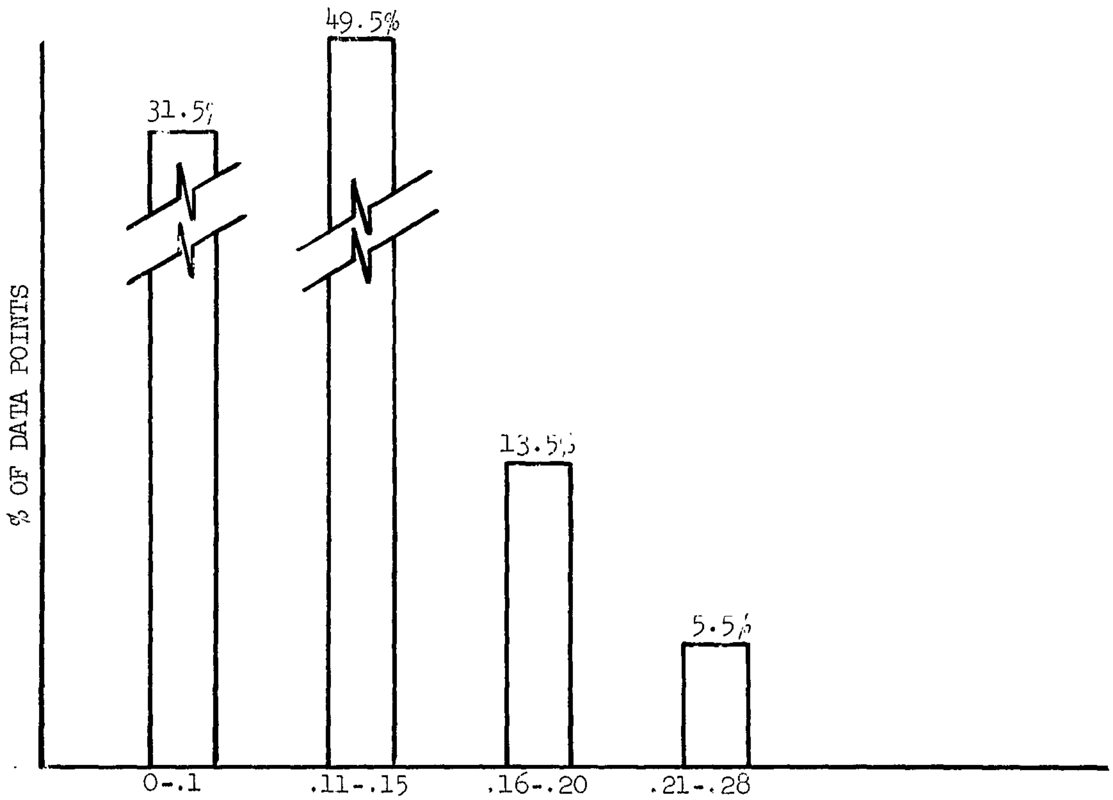


Unit #9B (Platinum Contacts) Test A



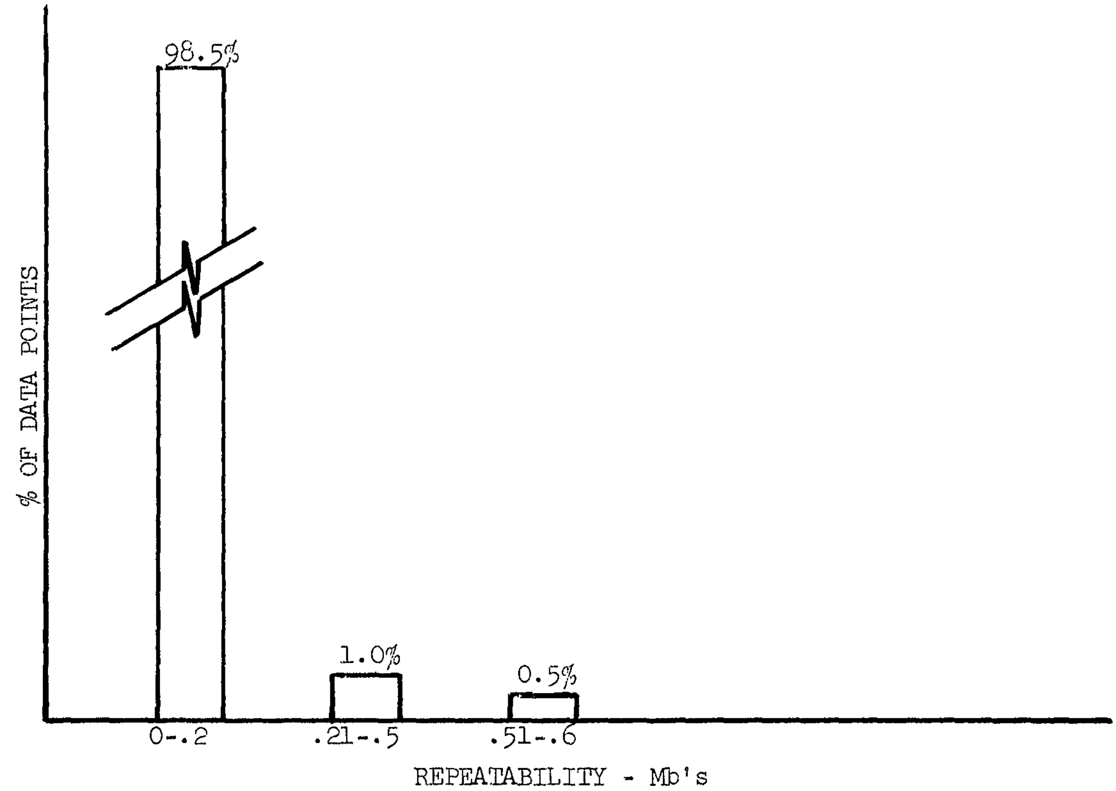
REPEATABILITY - Mb's

NOTE: Element #2 Leaked After 172 Scrubs

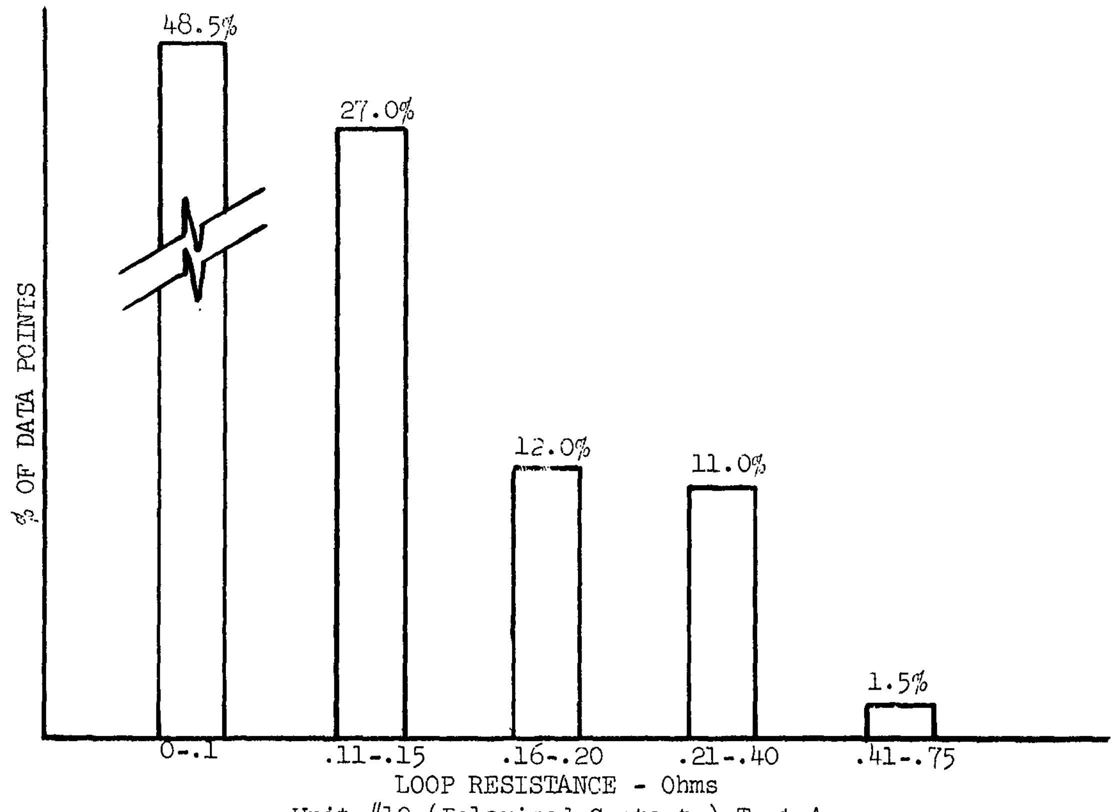


LOOP RESISTANCE - Ohms

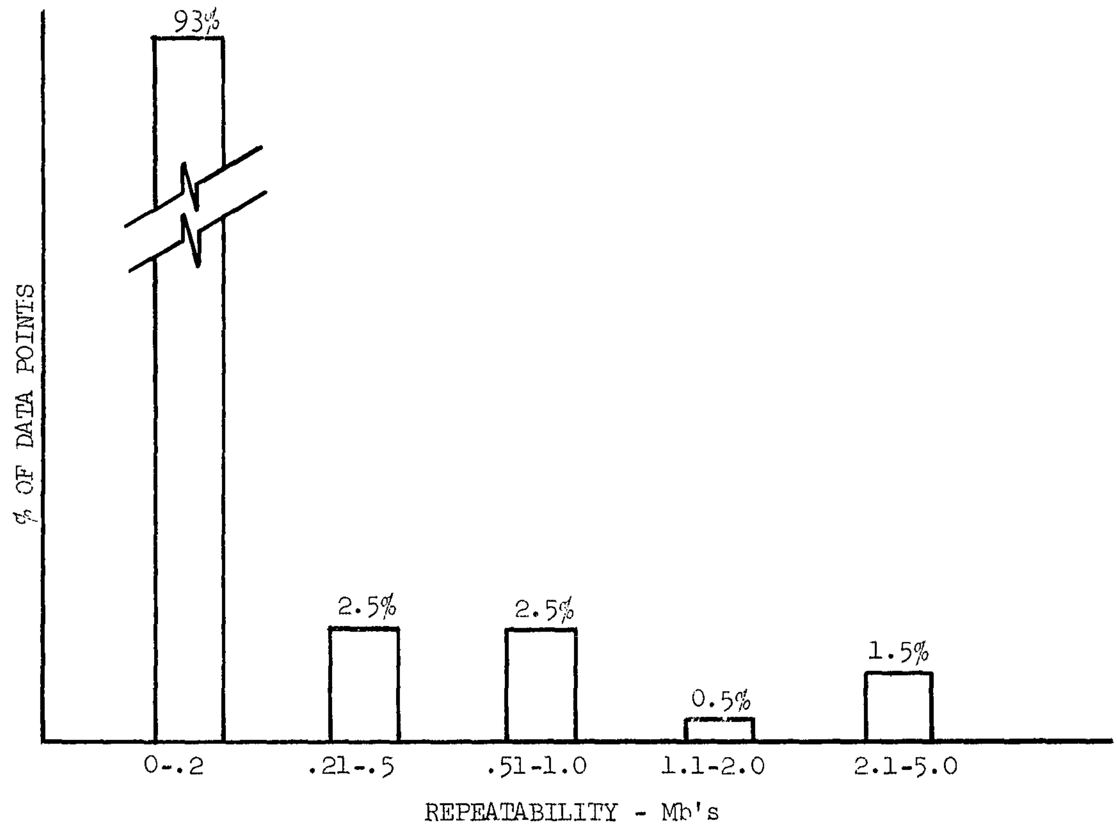
Unit #9B (Platinum Contacts) Test B



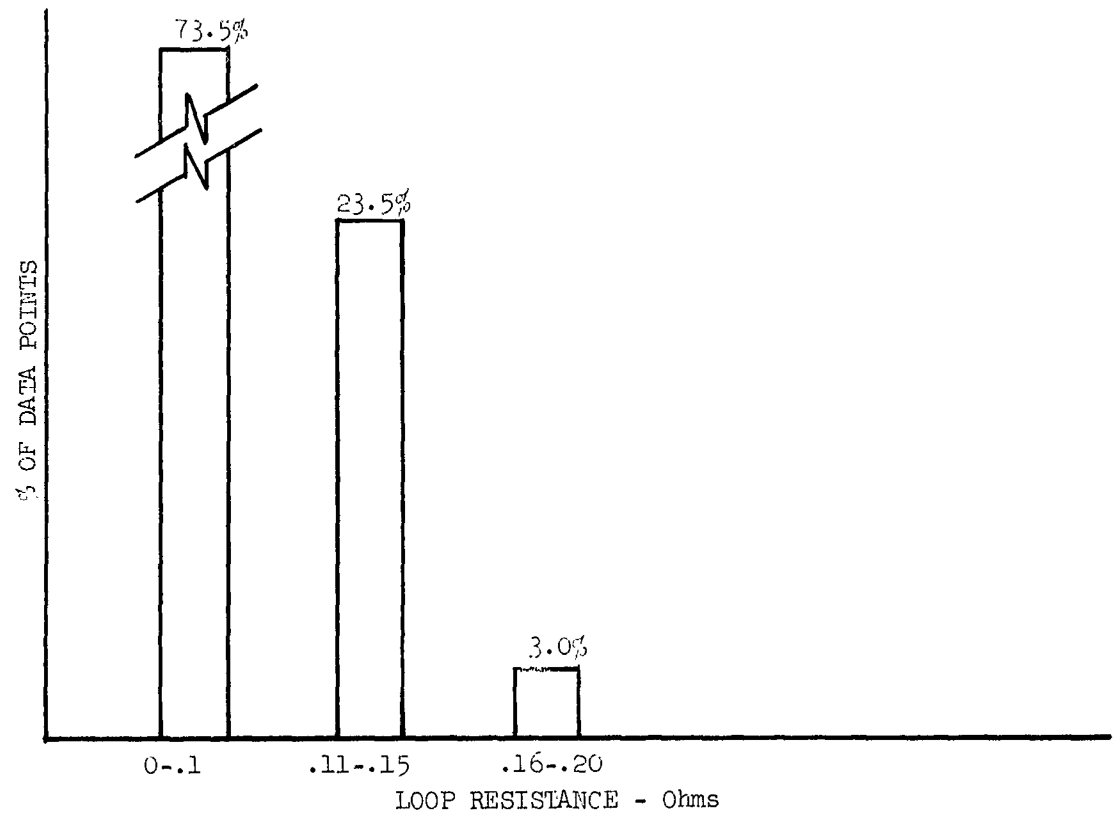
NOTES: New Contact Resistance Connections Added After Second Rm. Temperature Run. Element #4 Leaked After 120 Scrubs.



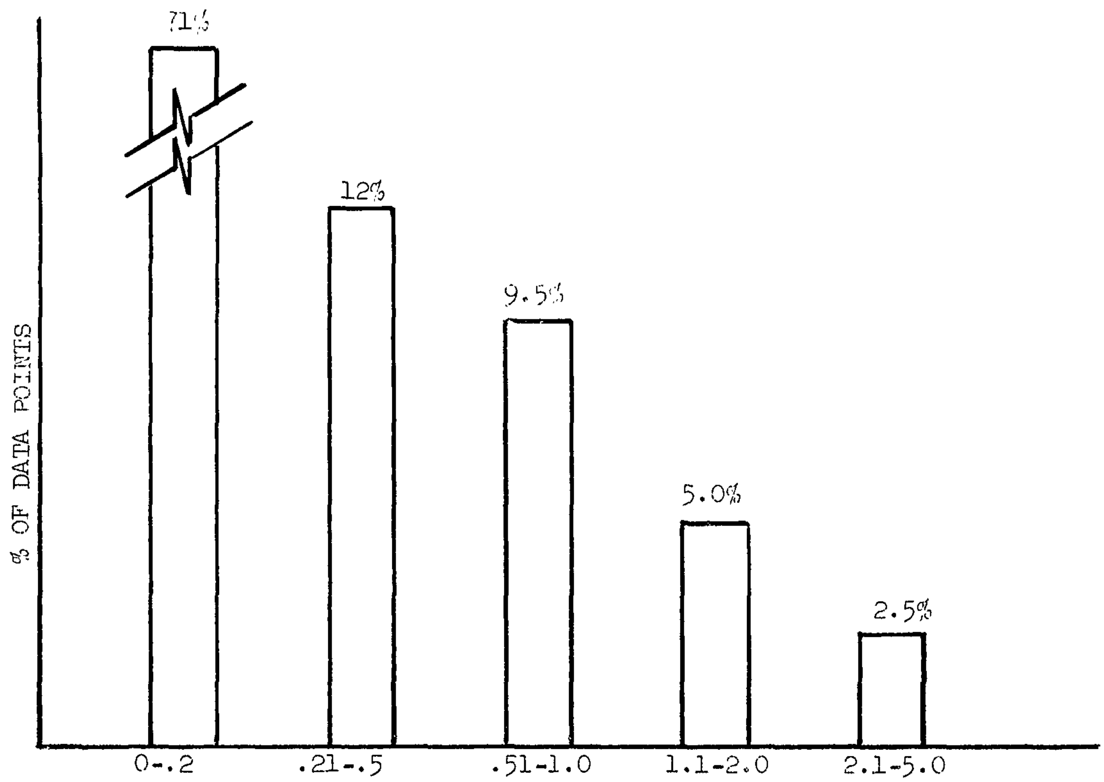
Unit #10 (Polarized Contacts) Test A



NOTE: Element #4 Leaked After 120 Scrubs

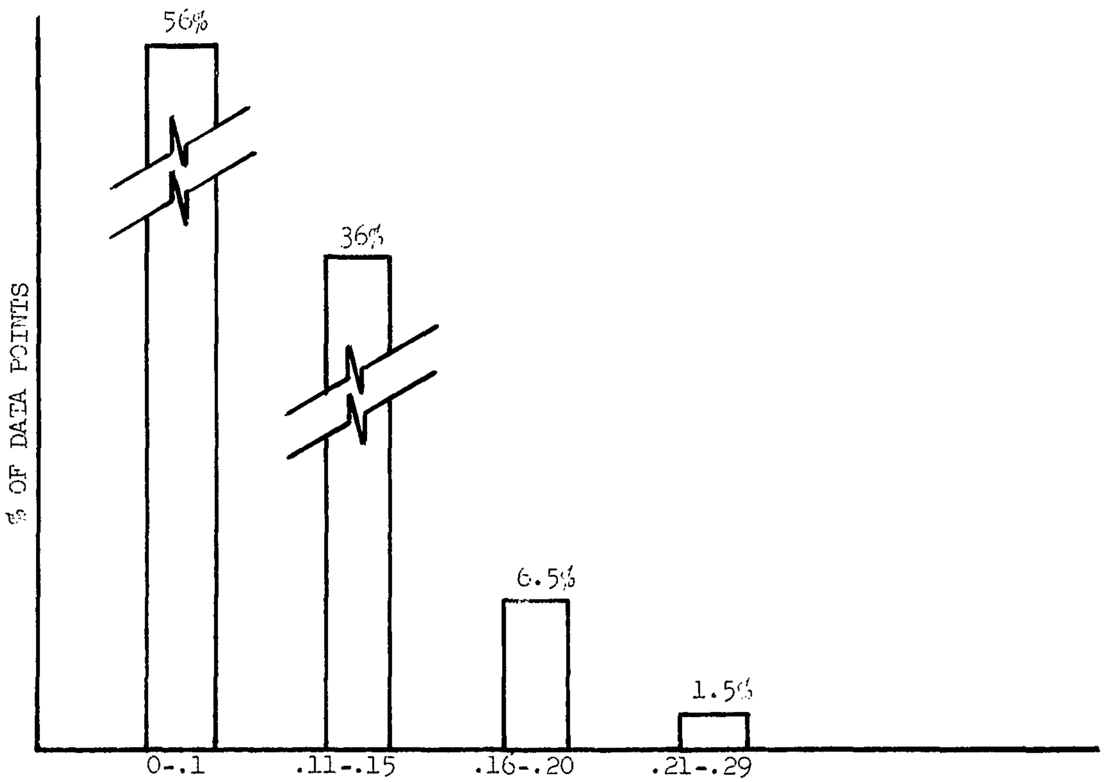


Unit #10 (Polarized Contacts) Test B



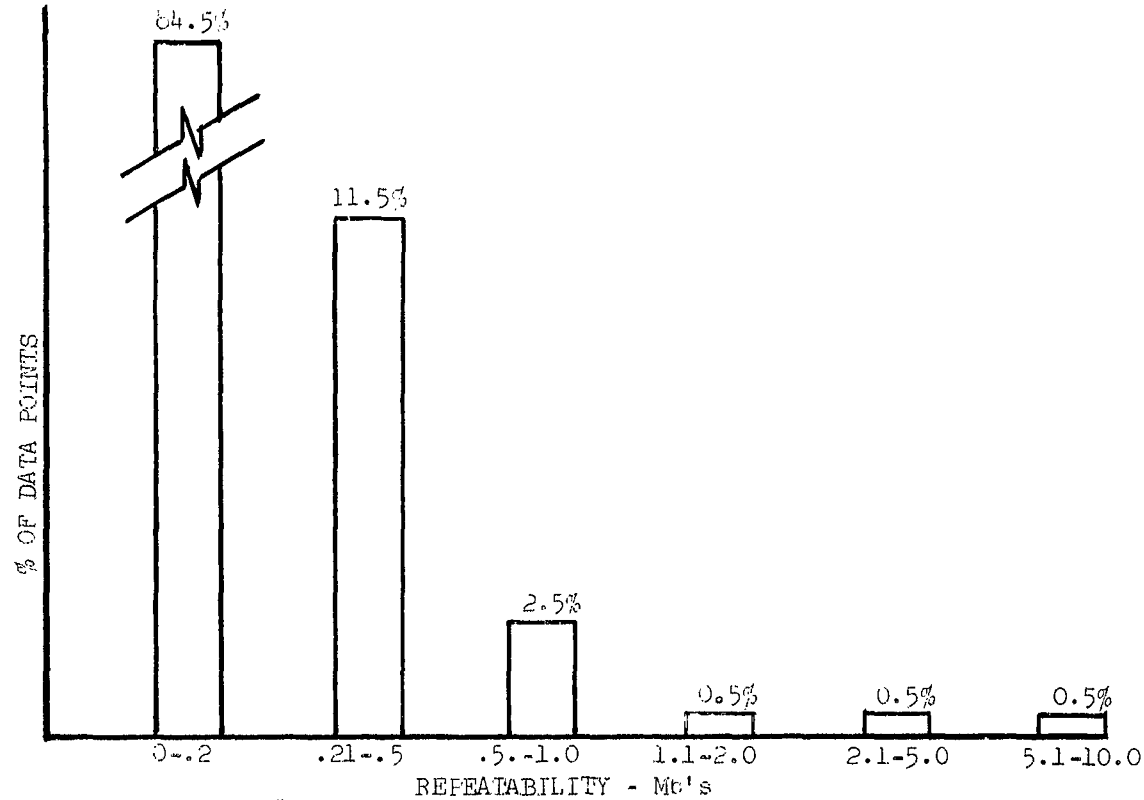
REPEATABILITY - Mb's

NOTE: Element #2 Leaked after 268 Scrubs

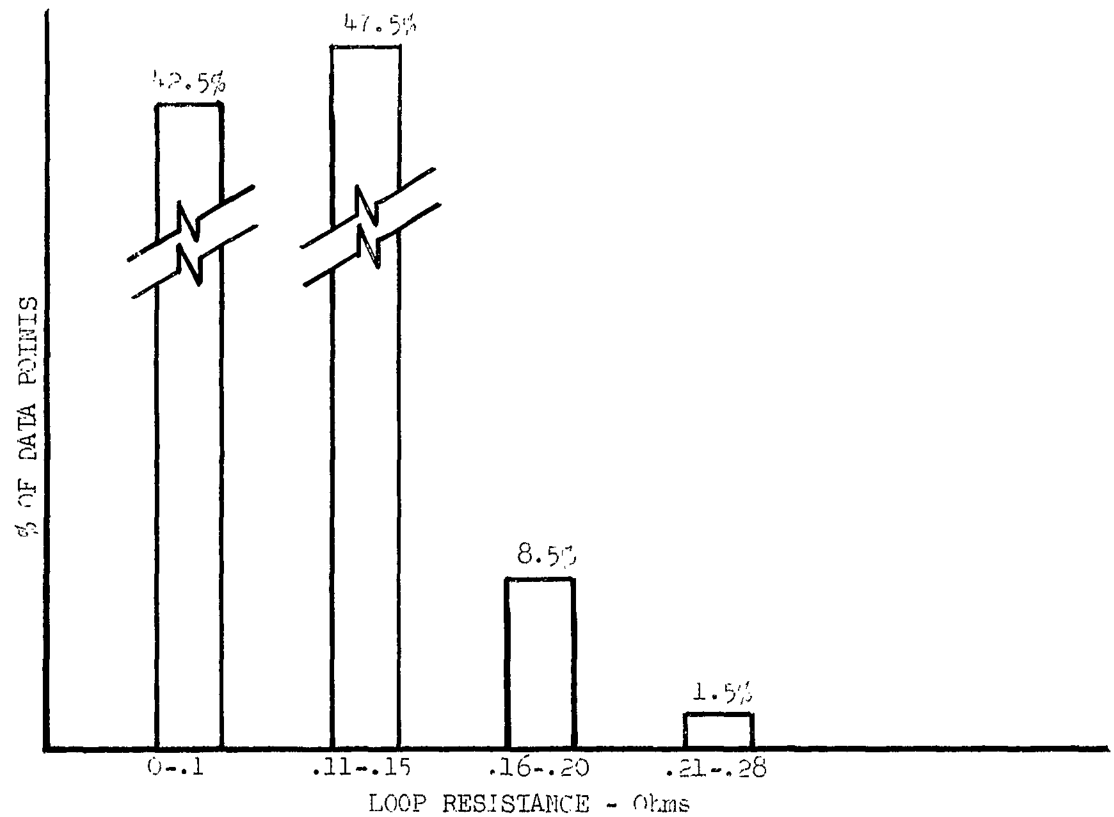


LOOP RESISTANCE - Ohms

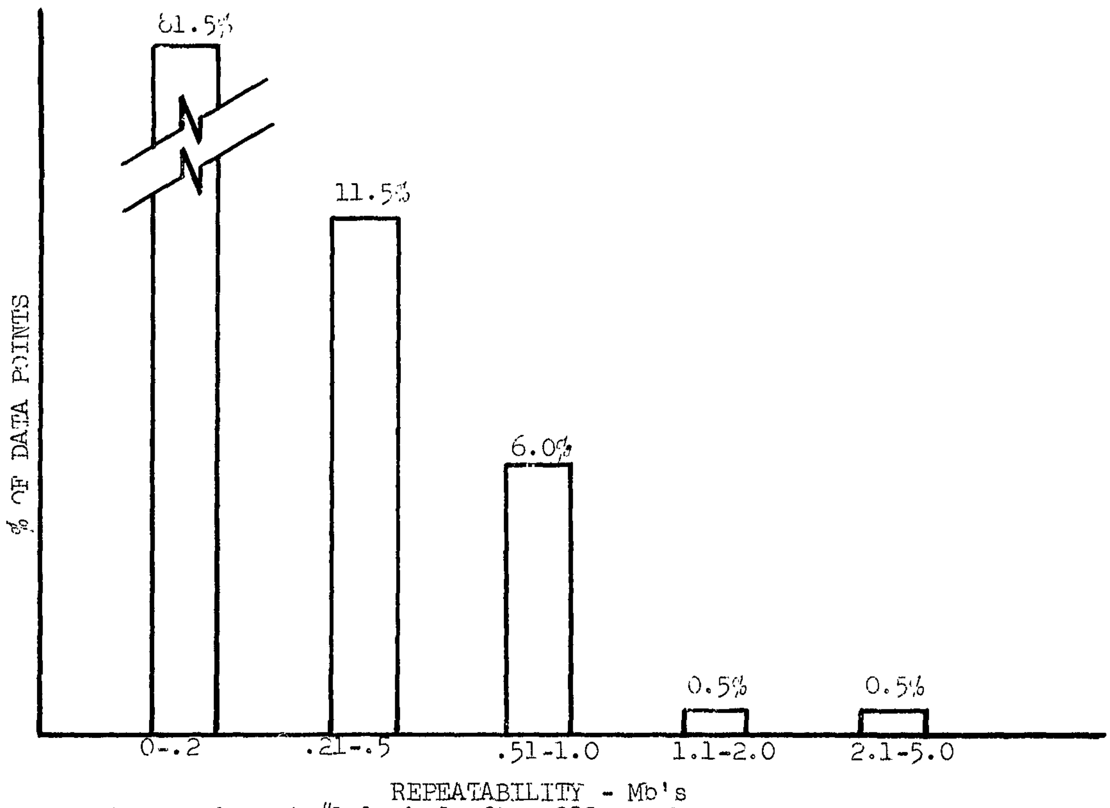
Unit #11 (Tungsten Contacts) Test B



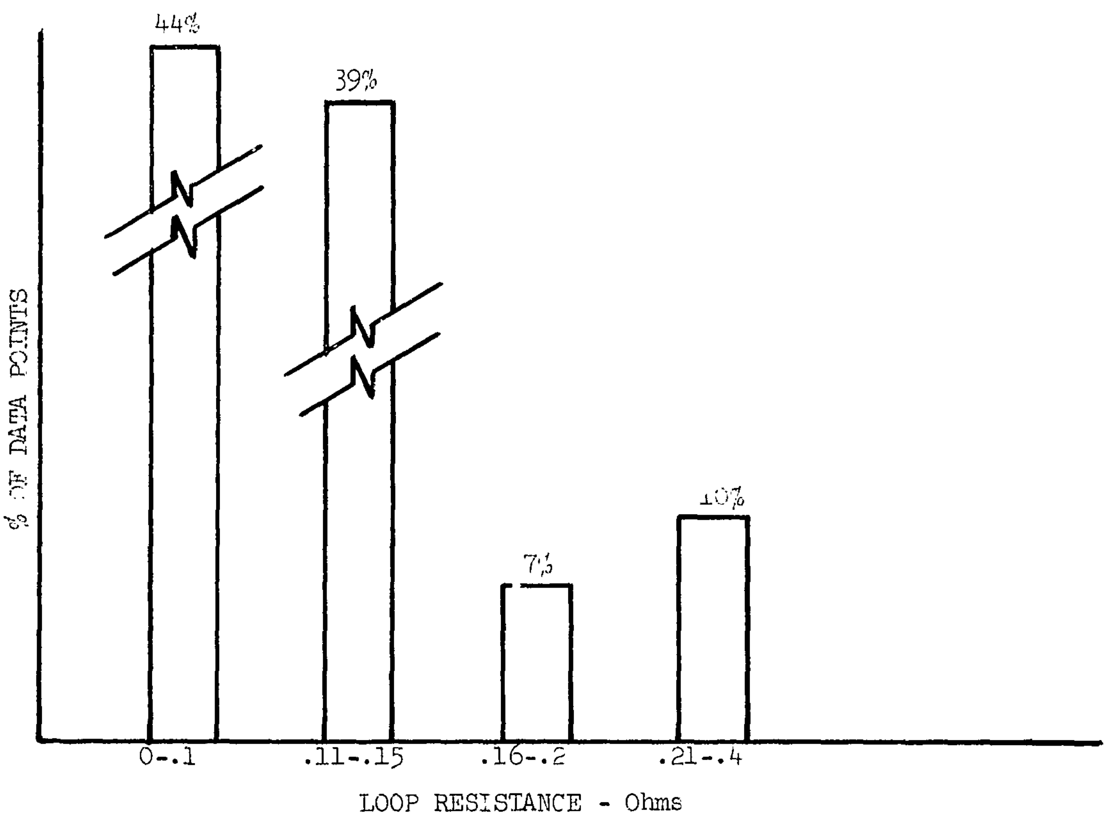
NOTE: Element #2 Leaked after 78 Scrubs
Element #4 Leaked after 85 Scrubs



Unit #12 (Platinum Contacts) Test B



NOTES: Element #1 leaked after 233 scrubs
Element #2 leaked after 170 scrubs
Element #4 leaked after 270 scrubs



Unit #13 (Polarized Contacts) Test B

APPENDIX "C"

APPENDIX 2

FIRST REPORT ON TUNGSTEN CONTACT TESTS

INTRODUCTION:

Because the tungsten cross-contacts intended for the XM-10 and XM-18 Baroswitches did not meet repeatability and loop resistance requirements after repeated contact scrubbing, a test program was initiated to determine what assembly techniques would provide the best contact characteristics.

DISCUSSION OF CONTACT PREPARATION AND ELEMENT ASSEMBLY:

Fifteen elements using 20 mil diameter tungsten wire as on the first XM-18 Baroswitches produced with tungsten contacts were assembled in lots of three, using the following contact preparation procedures:

A. 20 Mil tungsten wire contacts at 90°, surfaces not abraded.

B. 20 Mil tungsten wire contacts to which a smooth 1" radius of curvature has been applied with emery paper, and polished with rouge and a hand-held high-spped wheel.

C. Same as (B) except that the contacts are left in unpolished condition after the 1" radius has been generated.

D. Same as (B) except that the upper contact has not been rotated so that the angle between the contacts is now 45° instead of 90°.

E. Same as (B) except contacts on both upper and lower shelves are to be rotated 90° from the present configuration.

These 15 contact sets were prepared and assembled into element assemblies originally designated for the XM-10 Baroswitch.

The 20 mil tungsten wire was manufactured by Sylvania Electric, Towanda, Pennsylvania, and was purchased in 1957. It is Type NS30, with a unit weight of 780.00 mg/200 mm and is from lot no. AW 95-38GAAA.

DISCUSSION OF TESTING PROCEDURE:

The capsules were assembled into four XM-10 Baroswitches (no two alike capsules to a switch) in the following arrangement:

Figure 1. Unit #11, Element #4 (tungsten contacts) after Test "B".

Figure 2. Unit #12, Element #4 (platinum contacts) after Test "B".

Figure 3. Unit #13, Element #4 (polarized contacts) after Test "B". Platinum anode is on left, tungsten cathode on right.

	BAROSWITCH NUMBER			
Element No.	1	2	3	4
1	B_1	E_1	B_3	D_3
2	D_1	B_2	C_3	E_3
3	C_1	C_2	E_2	-
4	A_1	A_2	D_2	A_3

All elements had a 35 mb nitrogen backfill, and all baroswitches were rough ranged prior to testing. Baroswitches number 1 and 3 (elements A_1, B_1, B_3, C_1, C_3, D_1, D_2, and E_2) were overpressured 4 lbs. at 1000, 25,000 and 50,000 feet, and baroswitches number 2, 3, and 4 (elements A_2, A_3, B_2, B_3, C_2, C_3, D_2, D_3, E_1, E_2, and E_3) were outgassed prior to backfilling. Then the baroswitches were subjected to repeatability and loop resistance tests, as outlined below. F or Baroswitch Number 1, the altitude changes were made with the contacts open during the first five temperature cycles. For the remainder of cycles on Baroswitch Number 1, and all cycles on the other three switches, altitude changes were made with the contacts closed (scrubbing). A scrub is defined as an altitude change from 1,000 feet to 50,000 feet and back to 1,000 feet with the contacts closed.

OUTLINE OF BAROSWITCH TESTING PROCEDURES:

I. Room Temperature Runs

A. Three operating point readings were taken for each element at altitude settings of 1,000, 8,000, 15,000, 25,000, 40,000, and 50,000 feet. Repeatability was taken as the greatest difference between the readings at an altitude setting for a given element.

B. Loop resistance was measured at altitude settings of 1,000 25,000, and 50,000 feet for each element with 3 mb overpressure on the contacts.

II. Runs at -65°F

A. Steps IA and IB were repeated at -65°F.

III. Runs at +160°F.

A. Steps IA and IB were repeated at +160°F.

IV. Room Return Temperature Runs

A. Steps IA and IB were repeated at room temperature.

The above schedule was repeated four to eight times for each baroswitch. In going from one temperature cycle to another without interruption, the room return run of the preceding cycle was used as the room temperature run of the following cycle. Also, at the project manager's discretion, 10, 25, or 50 additional scrubs were added to the baroswitch elements between temperature cycles.

DISCUSSION OF TEST RESULTS

A synopsis of test results is given as Tables I and II. Table I gives a comparison of all elements with regard to the percent of data points greater than 0.5 mb on an element's repeatability curve, and percent of data points greater than 0.2 ohms and 0.4 ohms are given for each loop resistance curve. Table II shows the distribution of data points taken during scrubbing which are greater than 0.5 mb., 0.2 ohms or 0.4 ohms among the three temperature conditions of the test.

Inspection of Table I shows that element B_1 (contacts in standard orientation, 1" radius and polished, overpressured and 5 no-scrub cycles) has good repeatability and resistance characteristics. The other two B-type elements are poor in repeatability. Those elements which received overpressure and/or no-scrub cycling usually showed better characteristics than those which did not. The B and C-type elements showed the best loop resistance characteristics, and the A-type elements were best in repeatability.

Table II shows no recognizable pattern in repeatability versus temperature characteristics, and a slight increase in the percent of high loop resistance readings with an increase in temperature (noted in the greater-than-0.2 ohms column), as would be expected from the increased resistance of the baroswitch circuits at higher temperatures.

CONCLUSIONS

The amount of cold working (overpressure, no-scrub cycles) the tungsten contacts receive is indicative of how well they will perform in the scrub tests. The otherwise lack of data correlation would indicate that poor resistance and repeatability is due to something which all elements were subject to during all tests, the high contact pressures during scrubbing.

TABLE I

PERCENT OF DATA POINTS GREATER THAN 0.5 MBS, 0.2 OHMS OR 0.4 OHMS DURING SCRUBBING

ELEMENT NUMBER	PERCENT GREATER THAN .5 MB	PERCENT GREATER THAN 0.2 OHMS	0.4 OHMS	TOTAL NUMBER OF SCRUBS
A_1 (OP, NSC)*	12.5%	40%	0%	110
A_2 (OG)	10%	19%	4%	126
A_3 (OG)	34%	66%	37%	130
B_1 (OP, NSC)	11.3%	3%	0%	110
B_2 (OG)	45.5%	35%	10%	126
B_3 (OP, OG)	58%	31%	13%	118
C_1 (OP, NSC)	21%	22%	0%	110
C_2 (OG)	22%	10%	4%	126
C_3 (OP, OG)	47%	40%	19.5%	118
D_1 (OP, NSC)	40%	64%	24%	110
D_2 (OP, OG)	51.5%	19.5%	11%	118
D_3 (OG)	29.5%	14.5%	8%	130
E_1 (OG)	67%	12%	2%	126
E_2 (OP, OG)	33%	37.5%	15.5%	118
E_3 (OG)	46%	55%	27%	130

* OP = Overpressured 4# @ 1,000 feet, 25,000 feet, 50,000 feet.

OG = Outgassed

NSC = No Scrub Cycles. Elements were temperature-cycled five times with contacts opened during altitude setting changes before any scrubs were added.

TABLE II

DISTRIBUTION OF DATA POINTS GREATER THAN 0.5 MB, 0.2 OHMS OR 0.4 OHMS AMONG TEMPERATURE CONDITIONS DURING SCRUBBING DISTRIBUTION OF POINTS GREATER THAN:

Element Number	No. of Temp. Cycles	0.5 Mb.			0.2 Ohms			0.4 Ohms		
		-65°F.	Room**	+160°F.	-65°F.	Room **	+160°F.	-65°F.	Room**	+160°F.
A_1*	8	77%	23%	0%	43%	43%	14%	-	-	-
A_2	5	47%	6%	47%	39%	41%	20%	50%	50%	0%
A_3	6	29%	38.5%	32.5%	32%	36%	32%	29%	46%	25%
B_1*	8	38.5%	23%	38.5%	0%	100%(1 pt.)	0%	-	-	-
B_2	5	25%	42.5%	32.5%	36.5%	27%	36.5%	47%	29%	24%
B_3	4	36%	36%	28%	10.5%	26.5%	63%	0%	43%	57%
C_1*	8	83%	3.5%	13.5%	80%	0%	20%	-	-	-
C_2	5	28.5%	24%	47.5%	44%	12%	44%	0%	50%	50%
C_3	4	27%	33%	40%	26%	30%	44%	0%	50%	50%
D_1*	8	38%	19%	43%	26%	30%	44%	0%	33%	67%
D_2	4	25%	34%	41%	0%	33%	67%	0%	100%	0%
D_3	6	22%	41%	37%	24%	28.5%	47.5%	24%	28.5%	47.5%
E_1	5	36.5%	30.5%	33%	28%	16%	56%	0%	0%	100% (1 pt.)
E_2	4	43%	29.5%	27.5%	27%	46%	27%	25%	25%	50%
E_3	6	28%	40%	32%	32.5%	28%	39.5%	47.5%	28%	24.5%

Notes:
*Data points include only those taken during scrubbing.
**Room Temperature figures are corrected to compensate for more data points being taken at this temperature than the others.

SECOND REPORT ON TUNGSTEN CONTACT TESTS

INTRODUCTION

Following tests on 15 capsules with tungsten contacts, a second series of tests was conducted with General Electric .040" diameter tungsten wire. Also, further testing was done on Baroswitch #1.

DISCUSSION OF CONTACT MATERIALS AND CAPSULE PREPARATION

Three baroswitches (Nos. 1, 5, and 7) were prepared and tested following those tests described in Report No. 1. Baroswitch No. 1, which had received 110 scrubs in the first test series, was not altered except for an outgassing between the test series. Baroswitch No. 5 consisted of four identical capsules with G.E. No. 218, .040" diameter tungsten wire contacts, and baroswitch No. 7 had four identical capsules with G.E. .040" diameter tungsten wire contacts with 2% thorium oxide. Both contact materials were subjected to a centerless grinding operation at the factory, and the surfaces were not further abraded at Bendix Friez. All capsules in baroswitches Nos. 5 and 7 were purged and outgassed as per the 1312 baroswitch outgassing procedure.

TESTING PROCEDURE

Baroswitch No. 1 was subjected to five additional temperature-altitude cycles, as defined in the Testing Procedure section of Report No. 1. The first run was made with contacts closed during altitude setting changes, bringing the total scrub count to 118 on these contacts. The last four temperature altitude cycles were made with contacts open.

Baroswitches Nos. 5 and 7 received identical tests, outlined as follows:

1. A complete temperature-altitude cycle, as previously defined, was made with contacts closed during altitude setting changes. Then, a room temperature run was made, and 25 scrubs were added (total of 38 scrubs). Another room temperature run was made and 50 scrubs were added (total 90 scrubs). Then another complete temperature-altitude cycle was made, bringing the scrub total up to 98. Loop resistance was taken after each repeatability test.

2. The elements were set at 30,000 feet, and capsule pressure was cycled from 1000 mbs. to 0 mb. and back to 1000 mbs. (roughly). This step was repeated 50 times with loop resistance readings taken after each 10 dives.

3. Step 2 was repeated with altitude settings of 25,000 feet. The contacts were opened during the altitude setting change from 30,000 feet to 25,000 feet. The purpose of steps 2 and 3 were to see if the contact materials would be deformed enough during the dives at 30,000 feet to adversely affect repeatability and loop resistance readings at 25,000 feet, which represents a spot adjacent to the 30,000 foot setting on the contact diameters.

4. Following steps 2 and 3, the test procedure was as follows:

   After the 100 dives, repeatability and loop resistance were taken at room temperature. Then 100 scrubs were added (a total of 200) repeatability and loop resistance were again taken, and 100 more scrubs were added (a total of 302). Then a complete temperature-altitude cycle was made, with loop resistances taken after repeatability tests, to total 309 scrubs.

RESULTS AND CONCLUSIONS

Table I, showing percent of data points greater than 0.5 mb., 0.2 ohms, or 0.4 ohms for steps 1 and 4 of the testing procedure for baroswitches Nos. 5 and 7, is attached.

The results of testing on baroswitch No. 1 are comparable to those tests described in Report No. 1, except for an improvement in repeatability and loop resistance for element C_1.

The results of steps 2 and 3 in the Procedure section are as follows:

Baroswitch No. 5 showed an increase from 0.08 mb. average repeatability at 30,000 feet to 0.26 mb. average repeatability at 25,000 feet. Baroswitch No. 7 showed a decrease from 0.8 mb. average repeatability at 30,000 feet to 0.6 mb. at 25,000 feet. Average loop resistance readings are given below:

	Baroswitch No. 5	Baroswitch No. 7
30,000 ft. setting	.07 ohms average	.13 ohms average
25,000 ft. setting	.09 ohms average	.15 ohms average

The force applied to the contacts during these tests, approximately a half an atmosphere maximum overpressure with no scrubbing action, was not the worst condition the contacts were subjected to; i.e., nearly a full atmosphere maximum overpressure with scrubbing action during repeatability tests.

Table I shows that Baroswitch No. 5 has good repeatability and fair loop resistance, and Baroswitch No. 7 has fair loop resistance and fair repeatability. Data was influenced by two elements in baroswitch No. 5 leaking before testing was half complete.

TABLE I

PERCENT OF DATA POINTS GREATER THAN 0.5 MB, 0.2 OHMS OR 0.4 OHMS DURING SCRUBBING

	Percent Greater Than:			
Baroswitch No. 5	0.5 mb.	0.2 ohms	0.4 ohms	Total Number of Scrubs
Element No. 1	0%	16.5%	0%	89*
Element No. 2	0%	14%	5.5%	299*
Element No. 3	4.5%	18%	3%	129*
Element No. 4	5.5%	8.5%	0%	309
Baroswitch No. 7				
Element No. 1	1%	25%	4%	309
Element No. 2	19%	6%	0%	309
Element No. 3	3%	25%	0%	245*
Element No. 4	34%	8%	2%	309

*Capsules developed leaks at this point.

APPENDIX 3

File Ref: 32-0376-6
Contract No: DA-36-034-ORD-2890-RD

VIBRATION TEST ON XM-10 BAROSWITCHES

USING ROBINSON EXPERIMENTAL MOUNTS

INTRODUCTION:

This report is submitted to Picatinny Arsenal to provide information on recently conducted vibration tests requested by Picatinny Arsenal. Data is presented in tables and graphic form, and a summary analysis of the data is included.

TEST EQUIPMENT AND PROCEDURES:

The XM-10 units used in this test, Serial Nos. 0064-E2 and 0066-E2, contained platinum-iridium button contacts with approximately 3/4" radius. Both switches had been used in previous vibration tests. The mounts used were isolators from XM-18 shock mounts (items 2-9, Ordnance Drawing 8833173) on side plates designed for the XM-10 Baroswitch (Ordnance Drawing 1144704). One set of mounts was made and used for both baroswitches.

Testing was started on 11/22/62 and completed on 11/29/62. A synopsis of the testing procedure is as follows:

A. Vibration Inputs:

5-15-5 cps at 0.35" D.A. constant

15-2000-15 cps at 4g's constant

B. Sweep Times:

Four minutes, 10 minutes (each sweep time encompassing both inputs)

C. Altitudes:

10,216 ft. (3114 meters) (691 mb)

20,187 ft. (6153 meters) (462 mb)

49,995 ft. (15,238 meters) (116 mb)

D. Orientations:

X-2 Axis, Y-2 Axis, Z-1 Axis (stated axis pointed upward - See Figure 1).

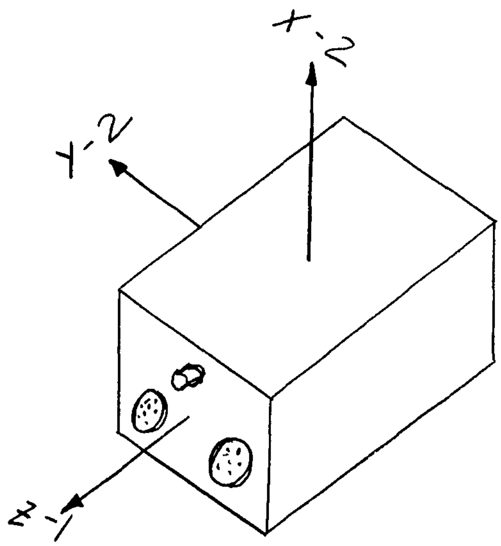


Figure 1

E. Contact Setting:

Contacts were set open 6 mb, test was conducted. If necessary, contacts were opened in increments of 2 mb until contact closures were eliminated. Contacts were set closed 6 mb, test conducted.

F. Sequence followed during vibration testing

SEQUENCE FOLLOWED DURING VIBRATION TESTING

Test No.	Unit No.	Axis	Sweep Time	Altitude
1	0064-E2	X-2	4 Min.	10,216 Ft.
2	0064-E2	X-2	10 Min.	10,216 Ft.
3	0064-E2	X-2	4 Min.	20,187 Ft.
4	0064-E2	X-2	10 Min.	20,187 Ft.
5	0064-E2	X-2	4 Min.	49,995 Ft.
6	0064-E2	X-2	10 Min.	49,995 Ft.
7	0064-E2	Y-2	4 Min.	10,216 Ft.
8	0064-E2	Y-2	10 Min.	10,216 Ft.
9	0064-E2	Y-2	4 Min.	20,187 Ft.
10	0064-E2	Y-2	10 Min.	20,187 Ft.
11	0064-E2	Y-2	4 Min.	49,995 Ft.
12	0064-E2	Y-2	10 Min.	49,995 Ft.
13	0064-E2	Z-1	4 Min.	10,216 Ft.
14	0064-E2	Z-1	10 Min.	10,216 Ft.
15	0064-E2	Z-1	4 Min.	20,187 Ft.
16	0064-E2	Z-1	10 Min.	20,187 Ft.
17	0064-E2	Z-1	4 Min.	49,995 Ft.
18	0064-E2	Z-1	10 Min.	49,995 Ft.
19	0066-E2	Y-2	4 Min.	10,216 Ft.
20	0066-E2	Y-2	10 Min.	10,216 Ft.
21	0066-E2	Y-2	4 Min.	20,187 Ft.
22	0066-E2	Y-2	10 Min.	20,187 Ft.
23	0066-E2	Y-2	4 Min.	49,995 Ft.
24	0066-E2	Y-2	10 Min.	49,995 Ft.
25	0066-E2	Z-1	4 Min.	10,216 Ft.
26	0066-E2	Z-1	10 Min.	10,216 Ft.
27	0066-E2	Z-1	4 Min.	20,187 Ft.
28	0066-E2	Z-1	10 Min.	20,187 Ft.
29	0066-E2	Z-1	4 Min.	49,995 Ft.
30	0066-E2	Z-1	10 Min.	49,995 Ft.
31	0066-E2	X-2	4 Min.	10,216 Ft.
32	0066-E2	X-2	10 Min.	10,216 Ft.

Test No.	Unit No.	Axis	Sweep Time	Altitude
33	0066-E2	X-2	4 Min.	20,187 Ft.
34	0066-E2	X-2	10 Min.	20,187 Ft.
35	0066-E2	X-2	4 Min.	49,995 Ft.
36	0066-E2	X-2	10 Min.	49,995 Ft.

G. Readout Equipment:

A 28 VDC, 40 micro-ampere load was impressed across each contact. Contact closures were monitored with readout equipment which filtered out closures of 50 microseconds or less.

H. Mount Transmissibility:

Transmissibility tests were made prior to contact chatter testing in the specified axes.

RESULTS:

Attachment No. 1 presents contact chatter data in tabular form. Descriptive symbols used are defined below:

NC = No contact chatter.

Hold -6 = Holding contacts open by 6 mb.

Hold +6 = Holding contacts closed by 6 mb.

NT = Not a valid test. Reasons explained in Discussion Section.

28-37, etc. = Constant or near constant chatter from 28 cps to 37 cps.

31,1700, etc. = Isolated chatter at these points.

Set Point = Actual pressure reading where contacts indicate closure.

Graphs plotting contact chatter vs. frequency for each test are attached.

Mount transmissibility information is tabulated in Attachment No. 2. All information is for the same set of mounts, taken with two different baroswitches. Graphs of transmissibility vs. frequency are attached.

DISCUSSION AND CONCLUSIONS:

The absence of test data from Element #1, Baroswitch #0066, during tests 23 through 36, was due to a short circuit in the capsule, necessitating in cutting away the electrical leads to the capsule so that the short would not affect chatter data.

A comparison between the results of this test program and the programs described in reports to Picatinny Arsenal dated June 13, 1962, by K. D. Shaub, and September 24, 1962 by D. M. Potter, (the latter reports describe similar vibration testing with the same two baroswitches, using XM-10 Lord mounts), shows favorably for the Robinson mounts in several respects.

1. Elimination of the wide chatter bands prevalent during X and Y axes testing with the Lord mounts.

2. A shift in the mount resonant point to the 30-40 cps range, and reduction in the maximum Y axis transmissibility from 7/1 to 2.4/1. The shift in resonance point was accompanied by a narrow bandwidth on the peak transmissibility spike (see attached graphs).

3. Elimination of chatter in the Z axis.

A comparison of like tests on the two switches, particularly tests 1-6 and 31-36 (X-axis), shows progressively worsening data from the mounts as vibration time increased. This is borne out by the tabulated transmissibility data.

Inspection of the mounts showed indication that the switches were striking the cushion cups (item 6, Ordnance Drawing 8833173). It could not be shown that this was being done during specification vibration testing, so the spacing of the isolators is termed marginally adequate. However, any available space should be utilized in extending the isolators along the X or Y axes of the baroswitch.

Bendix-Friez

ATTACHMENT NO. 1

Test #1 Unit #0064-E2 Axis (X-2) Mount Resonance 30 cps Transmissibility 2.9:1 Sweep 4 Min. Altitude: 10,216 Ft.					Test #31 Unit #0066-E2 Axis (X-2) Mount Resonance 37.5 cps Transmissibility 3.1:1 Sweep 4 Min. Altitude: 10,216 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686	688	688	686	N.T.	687	687	686.5
Hold	-8.0	-8.0	-8.0	-6.0	-	-6.5	-6.5	-6.0
5-2000	N.C.	N.C.	N.C.	N.C.	-	1700	1700	N.C.
2000-5	N.C.	N.C.	N.C.	N.C.	-	1700	1700	N.C.
				Set Check	-	687	687.5	688
				Hold	-	-8.5	-9.0	-9.5
				5-2000	-	1700	1700	N.C.
				2000-5	-	1700	N.C.	N.C.
				Hold	-	-10.5	-11.0	-11.5
				5-2000	-	1700	N.C.	N.C.
				2000-5	-	N.C.	N.C.	N.C.
				Hold	-	-12.5	-13.0	-13.5
				5-2000-5	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	687.5	688	690	686	N.T.	688	687.5	688
Hold	+8.5	+8.0	+6.0	[illegible]	-	+6.0	+6.5	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

Bendix-Friez

Test #2
Unit #0064-E2
Axis (X-2) Sweep 10 Min.
Altitude: 10,216 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	688	688	688	686
Hold	-8.0	-8.0	-8.0	-6.0
5-2000	1600	N.C.	32	N.C.
2000-5	N.C.	N.C.	N.C.	30
Hold	-10.0	-10.0	-10.0	-8.0
5-2000	N.C.	N.C.	N.C.	N.C.
2000-5	N.C.	N.C.	N.C.	N.C.

Test #32
Unit #0066-E2
Axis (X-2) Sweep 10 Min.
Altitude: 10,216 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	N.T.	668	687.5	688
Hold	-	-6.5	-6.0	-6.5
5-2000	-	1700	1700	N.C.
2000-5	-	1700	1700	N.C.
Hold	-	-8.5	-8.0	-8.5
5-2000	-	1700	1700	N.C.
2000-5	-	1700	1700	N.C.
Hold	-	-10.5	-10.0	-10.5
5-2000	-	1700	1700	N.C.
2000-5	-	1700	N.C.	N.C.
Hold	-	-12.5	-12.0	-12.5
5-2000	-	1700	N.C.	N.C.
2000-5	-	1700	N.C.	N.C.
Hold	-	-14.5	-14.0	-14.5
5-2000	-	1700	N.C.	N.C.
2000-5	-	N.C.	N.C.	N.C.
Hold	-	-16.5	-16.0	-16.5
5-2000-5	-	N.C.	N.C.	N.C.

Test #2 (continued)

(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	687.5	687.5	686	686.5
Hold	+6.5	+6.5	+6.0	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.

Test #3
Unit #0064-E2
Axis (X-2) Sweep 4 Min.
Altitude: 20,137 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	458	460.5	462	458.5
Hold	-6.0	-8.5	-10.0	-6.5
5-2000	33, 1700	62	1700	33
2000-5	1700, 32	65	1700	66
Hold	-5.0	-11.5	-12.0	-8.5
5-2000-5	N.C.	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	457	460	462	459
Hold	+11.0	+8.0	+6.0	+9.0
5-2000-5	N.C.	N.C.	N.C.	N.C.

Test #32 (continued)

Ele.#1	Ele.#2	Ele.#3	Ele.#4
N.T.	688	687.5	688
-	+6.0	+6.5	+6.0
-	N.C.	N.C.	N.C.

Test #33
Unit #0066-E2
Axis (X-2) Sweep 4 Min.
Altitude: 20,137 Ft.

Ele.#1	Ele.#2	Ele.#3	Ele.#4
N.T.	453	458.5	456.5
-	-6.0	-11.5	-9.5
-	1700	1700	N.C.
-	1700	N.C.	N.C.
-	-8.0	-13.5	-11.5
-	N.C.	N.C.	N.C.
Ele.#1	Ele.#2	Ele.#3	Ele.#4
N.T.	454	457	455.5
-	+9.0	+6.0	+7.5
-	N.C.	N.C.	N.C.

	Test #4 Unit #0064-E2 Axis (X-2) Sweep 10 Min. Altitude: 20,187 Ft.				Test #34 Unit #0066-E2 Axis (X-2) Sweep 10 Min. Altitude: 20,187 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	456.5	459	462	460	N.T.	453	458.5	456.5
Hold	-6.0	-8.5	-11.5	-9.5	-	-6.0	-11.5	-9.5
5-2000	55, 75, 1700	N.C.	1700	N.C.	-	32, 1700	1700	N.C.
2000-5	1700, 85, 31	N.C.	1700	N.C.	-	1700	N.C.	N.C.
Set Point	457	460	462	459	N.T.	454	458	456
Hold	-8.0	-11.0	-13.0	-10.0	-	-8.0	-12.0	-10.0
5-2000	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
2000-5	N.C.	N.C.	N.C.	N.C.	-	32	N.C.	N.C.
				Hold	-	-10.0	-14.0	-12.0
				5-2000-5	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	457	460	462	459	N.T.	454	457	455.5
Hold	+11.0	+8.0	+6.0	+9.0	-	+9.0	+6.0	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #5 Unit #0064-E2 Axis (X-2) Sweep 4 Min. Altitude: 49,995 Ft.				Test #35 Unit #0066-E2 Axis (X-2) Sweep 4 Min. Altitude: 49,995 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	116	118	122	118	N.T.	112	114	116
Hold	-6.0	-8.0	-12.0	-8.0	-	-6.0	-8.0	-10.0
5-2000	27, 55	27	N.C.	30, 1500	-	1600	N.C.	N.C.
2000-5	70, 58	70, 33	N.C.	N.C.	-	1700	N.C.	N.C.
Set Check	116.5	118.5	119	120.5	-	113.5	115	116.5
Hold	-8.0	-10.0	-10.5	-12.0	-	-8.0	-9.5	-11.0
5-2000	N.C.	N.C.	N.C.	N.C.	-	1700	N.C.	1700
2000-5	N.C.	N.C.	N.C.	N.C.	-	1700	N.C.	N.C.
				Hold	-	-10.0	-11.5	-13.0
				5-2000	-	N.C.	N.C.	1700
				2000-5	-	N.C.	N.C.	N.C.
				Hold	-	-12.0	-13.5	-15.0
				5-2000-5	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	116	118	122	119	N.T.	113.5	115	117
Hold	+12.0	+10.0	+6.0	+9.0	-	+9.5	+8.0	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #6 Unit #0064-E2 Axis (X-2) Sweep 10 Min. Altitude: 49,995 Ft.				Test #36 Unit #0066-E2 Axis (X-2) Sweep 10 Min. Altitude: 49,995 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	116.5	118.5	120.5	118	N.T.	113.5	114.5	117.5
Hold	-6.0	-8.0	-10.0	-7.5	-	-6.0	-7.0	-10.0
5-2000	26, 65-68, 75, 1650	28-37 68, 72	1650	28, 31	-	16, 30-34, 1600	1600	N.C.
2000-5	1650, 82 73-68, 63, 38, 35	1650, 73, 35	35	35	-	1600, 38, 30	N.C.	N.C.
Hold	-8.0	-10.0	-12.0	-9.5	-	-8.0	-9.0	-12.0
5-2000	66	30, 35	N.C.	N.C.	-	34,1600	N.C.	1600
2000-5	32	1600, 32	N.C.	N.C.	-	1700	N.C.	N.C.
Set Check	116	118	121.5	119	-	113.5	114.5	117.5
Hold	-10.0	-12.0	-15.5	-13.0	-	-10.0	-11.0	-14.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	116	118	122	119	N.T.	113.5	115	117
Hold	+12.0	+10.0	+6.0	+9.0	-	+9.5	+8.0	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

Test #7
Unit #0064-E2
Axis (Y-2) Mount Resonance 37 cps
Transmissibility 2.05:1 Sweep 4 Min.
Altitude: 10,216 Ft.

Test #19
Unit #0066-E2
Axis (Y-2) Mount Resonance 33 cps
Transmissibility 2.37:1 Sweep 4 Min.
Altitude: 10,216 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686	686.5	687.5	686.5	687	689	689	687
Hold	-6.0	-6.5	-7.5	-6.5	-6.0	-8.0	-8.0	-6.0
5-2000	32	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
Set Check	686.5	687	690	686.5				
Hold	-7.5	-8.0	-11.0	-7.5				
5-2000	32	N.C.	35	N.C.				
2000-5	N.C.	N.C.	N.C.	N.C.				
Hold	-9.5	-10.0	-13.0	-9.5				
5-2000-5	N.C.	N.C.	N.C.	N.C.				
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686.5	687	690	687	686	689	688.5	687.5
Hold	+9.5	+9.0	+6.0	+9.0	+9.0	+6.0	+6.5	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

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	Test #8 Unit #0064-E2 Axis (Y-2) Sweep 10 Min. Altitude: 10,216 Ft.				Test #20 Unit #0066-E2 Axis (Y-2) Sweep 10 Min. Altitude: 10,216 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686.5	687	690	686.5	687.5	689	688.5	687.5
Hold	-6.0	-6.5	-9.5	-6.0	-6.0	-7.5	-7.0	-6.0
5-2000	32, 38	35	N.C.	35	N.C.	N.C.	N.C.	N.C.
2000-5	38-34	38-34	N.C.	38-34	N.C.	N.C.	N.C.	N.C.
Set Check	686.5	687	690	687.5				
Hold	-8.0	-8.5	-11.5	-9.0				
5-2000-5	N.C.	N.C.	N.C.	N.C.				
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686.5	687	690	687	686.5	689	688.5	687.5
Hold	+9.5	+9.0	+6.0	+9.0	+8.5	+6.0	+6.5	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

	Test #9 Unit #0064-E2 Axis (Y-2) Sweep 4 Min. Altitude: 20,187 Ft.				Test #21 Unit #0066-E2 Axis (Y-2) Sweep 4 Min. Altitude: 20,187 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	457.5	458	459	459	452.5	456	458	458
Hold	-6.0	-6.5	-7.5	-7.5	-6.0	-9.5	-11.5	-11.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

	Test #9 (continued)				Test #21 (continued)			
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	456.5	458.5	459	458.5	452.5	456	458	458
Hold	+8.5	+6.5	+6.0	+6.5	+11.5	+8.0	+6.0	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

Test #10
Unit #0064-E2
Axis (Y-2) Sweep 10 Min.
Altitude: 20,187 Ft.

Test #22
Unit #0066-E2
Axis (Y-2) Sweep 10 Min.
Altitude: 20,187 Ft.

	Test #10				Test #22			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	456.5	458.5	459	458.5	452.5	456	458	458
Hold	-6.0	-8.0	-8.5	-8.0	-6.0	-9.5	-11.5	-11.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	456	457.5	460	458	452.5	456	458	458
Hold	+10.0	+8.5	+6.0	+8.0	+11.5	+8.0	+6.0	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

Test #11
Unit #0064-E2
Axis (Y-2) Sweep 4 Min.
Altitude: 49,995 Ft.

Test #23
Unit #0066-E2
Axis (Y-2) Sweep 4 Min.
Altitude: 49,995 Ft.

	Test #11				Test #23			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	114	118	119	118	N.T.	114.5	116	117.5
Hold	-6.0	-10.0	-11.0	-10.0	-	-6.0	-7.5	-9.0

Test #11 (continued) | Test #23 (continued)

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
5-2000	N.C.	N.C.	N.C.	N.C.	-	34	N.C.	N.C.
2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
				Hold	-	-8.0	-9.5	-11.0
				5-2000-5	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	114	117.5	119	118.5	N.T.	114	116	117.5
Hold	+11.0	+7.5	+6.0	+6.5	-	+9.5	+7.5	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

Test #12
Unit #0064-E2
Axis (Y-2) Sweep 10 Min.
Altitude: 49,995 Ft.

Test #24
Unit #0066-E2
Axis (Y-2) Sweep 10 Min.
Altitude: 49,995 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	114.5	117.5	119	118.5	N.T.	114	116	117
Hold	-6.0	-9.0	-10.5	-10.0	-	-6.0	-8.0	-9.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
Set Point	114	117.5	119.5	118.5	N.T.	114	116	117.5
Hold	+11.5	+8.0	+6.0	+7.0	-	+9.5	+7.5	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

Test #13
Unit #0064-E2
Axis (Z-1) Mount Resonance 36 cycles
Transmissibility 2.52:1 Sweep 4 Min.
Altitude: 10,216 Ft.

Test #25
Unit #0066-E2
Axis (Z-1) Mount Resonance 34 cps
Transmissibility 1.9:1 Sweep 4 Min.
Altitude: 10,216 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686	686.5	690	687	N.T.	690	688	688
Hold	-6.0	-6.5	-10.0	-7.0	-	-8.0	-6.0	-6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686	687	690	687	N.T.	689.5	686	688
Hold	+10.0	+9.0	+6.0	+9.0	-	+6.0	+7.5	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

Test #14
Unit #0064-E2
Axis (Z-1) Sweep 10 Min.
Altitude: 10,216 Ft.

Test #26
Unit #0066-E2
Axis (Z-1) Sweep 10 Min.
Altitude: 10,216 Ft.

(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	686	687	690	687	N.T.	690	688	688
Hold	-6.0	-7.0	-10.0	-7.0	-	-8.0	-6.0	-6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #14 (continued)				Test #26 (continued)			
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	685.5	686	689.5	686	N.T.	689.5	688	688
Hold	+10.0	+9.5	+6.0	+9.5	-	+6.0	+7.5	+7.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #15 Unit #0064-E2 Axis (Z-1) Sweep 4 Min. Altitude: 20, 187 Ft.				Test #27 Unit #0066-E2 Axis (Z-1) Sweep 4 Min. Altitude: 20,187 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	454.5	458	458	459	N.T.	456	458.5	455
Hold	-6.0	-9.5	-9.5	-10.5	-	-7.0	-9.5	-6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#3
Set Point	455.5	458	458.5	458	N.T.	456	458.5	455
Hold	+9.0	+6.5	+6.0	+6.5	-	+8.5	+6.0	+9.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #16 Unit #0064-E2 Axis (Z-1) Sweep 10 Min. Altitude: 20,187 Ft.				Test #28 Unit #0066-E2 Axis (Z-1) Sweep 10 Min. Altitude: 20,187 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	455	458	457.5	458.5	N.T.	456	458.5	455
Hold	-6.0	-9.0	-8.5	-9.5	-	-7.0	-9.5	-6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	455.5	458	458.5	458	N.T.	456	458.5	455
Hold	+9.0	+6.5	+6.0	+6.5	-	+8.5	+6.0	+9.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #17 Unit #0064-E2 Axis (Z-1) Sweep 4 Min. Altitude: 49,995 Ft.				Test #29 Unit #0066-E2 Axis (Z-1) Sweep 4 Min. Altitude: 49,995 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	115	117	122	117.5	N.T.	112	115	117.5
Hold	-6.0	-8.0	-13.0	-8.5	-	-6.0	-9.0	-11.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	114	117	122	117.5	N.T.	112	115	116.5
Hold	+14.0	+11.0	+6.0	+10.5	-	+10.5	+7.5	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

	Test #18 Unit #0064-E2 Axis (Z-1) Sweep 10 Min. Altitude: 49,995 Ft.				Test #30 Unit #0066-E2 Axis (Z-1) Sweep 10 Min. Altitude: 49,995 Ft.			
(OPEN)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	115	117	122	117.5	N.T.	112	115	117.5
Hold	-6.0	-8.0	-13.0	-8.5	-	-6.0	-9.0	-11.5
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.
(CLOSED)	Ele.#1	Ele.#2	Ele.#3	Ele.#4	Ele.#1	Ele.#2	Ele.#3	Ele.#4
Set Point	115	117	122	118	N.T.	112	115	116.5
Hold	+13.0	+11.0	+6.0	+10.0	-	+10.5	+7.5	+6.0
5-2000-5	N.C.	N.C.	N.C.	N.C.	-	N.C.	N.C.	N.C.

ATTACHMENT NO. 2

Transmissibility
Robinson Experimental
Mounts on XM-10 Baro #0064-E2

4 G's Constant Input

(X-2)			(Y-2)			(Z-1)		
CPS	G's Out	Trans.	CPS	G's Out	Trans.	CPS	G's Out	Trans.
15	4.3	1.1/1	15	4	1/1	15	4.8	1.2/1
25	6.6	1.65/1	25	5	1.25/1	25	6.8	1.7/1
30 (max.)	11.5	2.9/1	30	6.3	1.58/1	30	8.5	2.12/1
35	8.6	2.15/1	37 (max.)	8.2	2.05/1	36 (max.)	10.1	2.52/1
45	4.9	1.22/1	40	6.4	1.6/1	40	5.6	1.4/1
55	3.2	0.8/1	50	4.3	1.07/1	50	4.4	1.1/1
75	2.0	0.5/1	75	2.1	0.525/1	75	3.7	0.925/1
100	1.5	0.38/1	100	3.0	0.75/1	100	3.3	0.825/1
200	.68	0.17/1	200	2.8	0.7/1	200	1.8	0.45/1
300	.48	0.12/1	300	1.1	0.275/1	300	.92	0.23/1
400	1.4	0.35/1	400	.48	0.12/1	400	.63	0.158/1
450	3.1	0.78/1						
500	.80	0.20/1	500	.53	0.132/1	500	.46	0.115/1
600	.41	0.10/1	600	.45	0.113/1	600	.56	0.14/1
700	.3	0.075/1	700	.45	0.113/1	700	.60	0.15/1
800	$<$.1	$<$0.025/1	800	.45	0.113/1	800	.64	0.16/1

(X-2)			(Y-2)			(Z-1)		
CPS	G's Out	Trans.	CPS	G's Out	Trans.	CPS	G's Out	Trans.
900	.1	0.025/1	900	.9	0.225/1	900	.90	0.225/1
1000	.21	0.05/1	1000	.43	0.108/1	1000	.64	0.16/1
1100	.1	0.025/1	1100	.27	0.068/1	1100	.29	0.073/1
1200	.1	0.025/1	1200	<.1	<0.025/1	1200	<.1	<0.025/1
1300	<.1	<0.025/1	1300	.11	0.028/1	1300	.17	0.043/1
1400	<.1	<0.025/1	1400	.14	0.035/1	1400	.12	0.03/1
1500	<.1	<0.025/1	1500	.27	0.068/1	1500	<.1	<0.025/1
1600	<.1	<0.025/1	1600	.24	0.06/1	1600	.1	0.025/1
1700	<.1	<0.025/1	1700	.12	0.03/1	1700	<.1	<0.025/1
1800	<.1	<0.025/1	1800	.5	0.125/1	1800	<.1	<0.025/1
1900	<.1	<0.025/1	1900	<.1	<0.025/1	1900	.17	0.043/1
2000	<.1	<0.025/1	2000	.16	0.04/1	2000	.12	0.03/1

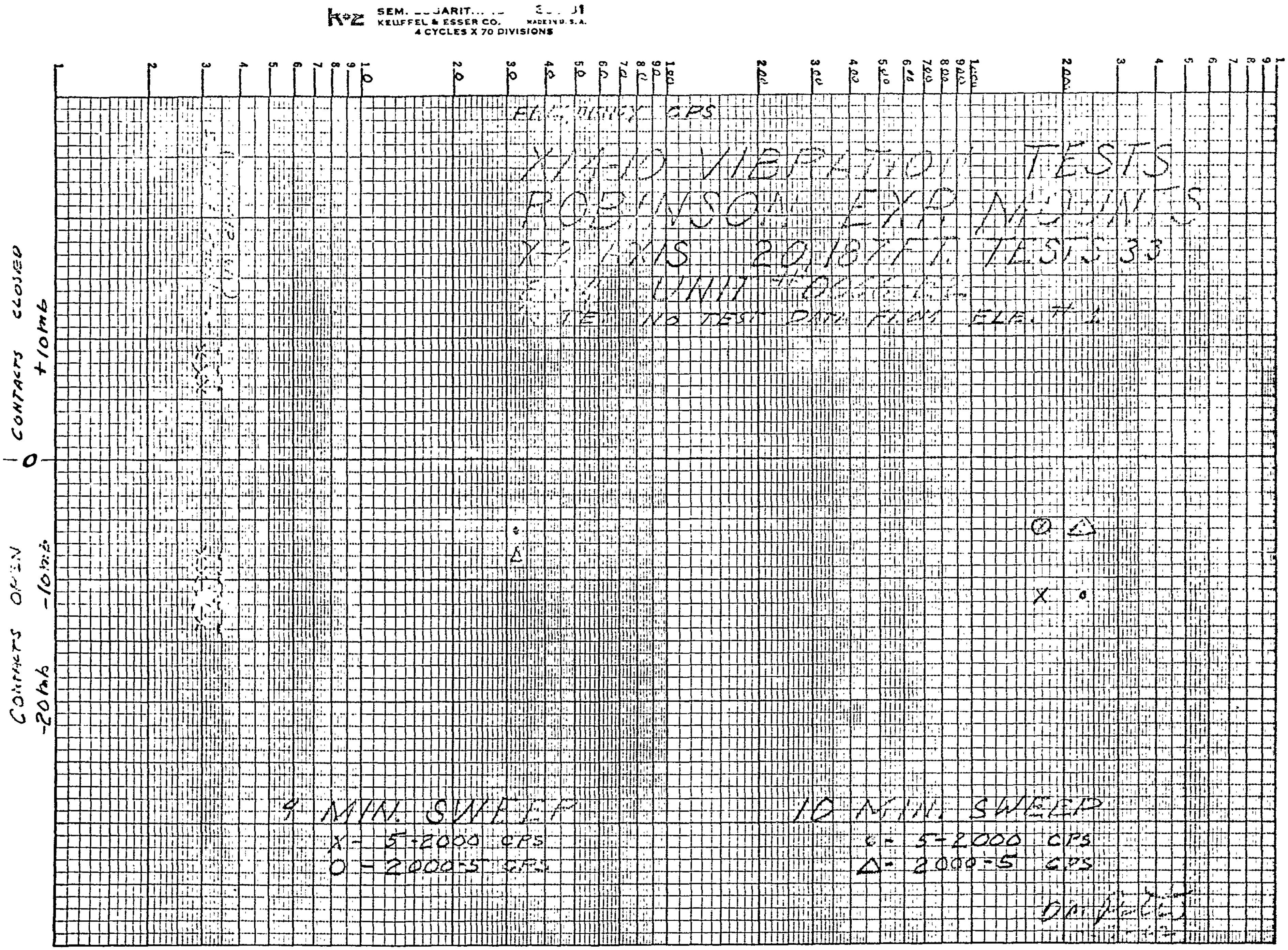
Transmissibility
Robinson Experimental
Mounts on XM-10 Baro #0066-E2

4 G's Constant Input

(X-2)			(Y-2)			(Z-1)		
CPS	G's Out	Trans.	CPS	G's Out	Trans.	CPS	G's Out	Trans.
15	4.7	1.18/1	15	4.8	1.2/1	15	5	1.25/1
25	5.6	1.4/1	25	6.7	1.67/1	25	5.3	1.32/1
30	10.5	2.62/1	30	8.3	2.08/1	30	7.2	1.8/1
37.5 (max.)	12.3	3.1/1	33 (max.)	9.5	2.37/1	34 (max.)	7.5	1.9/1

(X-2)			(Y-2)			(Z-1)		
CPS	G's Out	Trans.	CPS	G's Out	Trans.	CPS	G's Out	Trans.
40	11.0	2.75/1	40	5.3	1.32/1	40	5.8	1.45/1
45	6.4	1.6/1						
50	3.3	0.825/1	50	4.0	1.0/1	50	4.3	1.08/1
75	1.7	0.425/1	75	3.3	0.825/1	75	3.0	0.75/1
100	2.4	0.6/1	100	3.4	0.85/1	100	2.6	0.65/1
200	2.1	0.525/1	200	1.6	0.4/1	200	1.7	0.425/1
300	2.5	0.625/1	300	1.1	0.275/1	300	1.0	0.25/1
400	1.1	0.275/1	400	.70	0.175/1	400	.55	0.138/1
500	.31	0.078/1	500	.60	0.15/1	500	.38	0.095/1
600	.26	0.065/1	600	.50	0.125/1	600	.49	0.122/1
700	.12	0.03/1	700	.46	0.115/1	700	.44	0.11/1
800	.14	0.035/1	800	.49	0.122/1	800	.75	0.188/1
900	.40	0.4/1	900	.80	0.2/1	900	.22	0.055/1
1000	.13	0.033/1	1000	.53	0.132/1	1000	.18	0.045/1
1100	.11	0.028/1	1100	.24	0.06/1	1100	<.1	<0.025/1
1200	.13	0.033/1	1200	<.1	<0.025/1	1200	<.1	<0.025/1
1300	.12	0.03/1	1300	.18	0.045/1	1300	.13	0.033/1
1400	.18	0.045/1	1400	<.1	<0.025/1	1400	.14	0.035/1
1500	.16	0.04/1	1500	<.1	<0.025/1	1500	<.1	<0.025/1
1600	.17	0.043/1	1600	<.1	<0.025/1	1600	.11	0.028/1

(X-2)			(Y-2)			(Z-1)		
CPS	G's Out	Trans.	CPS	C's Out	Trans.	CPS	G's Out	Trans.
1700	.27	0.068/1	1700	.1	0.025/1	1700	.2	0.05/1
1800	.16	0.04/1	1800	.12	0.03/1	1800	.12	0.03/1
1900	.2	0.05/1	1900	.13	0.033/1	1900	.14	0.035/1
2000	.13	0.033/1	2000	.14	0.035/1	2000	.11	0.028/1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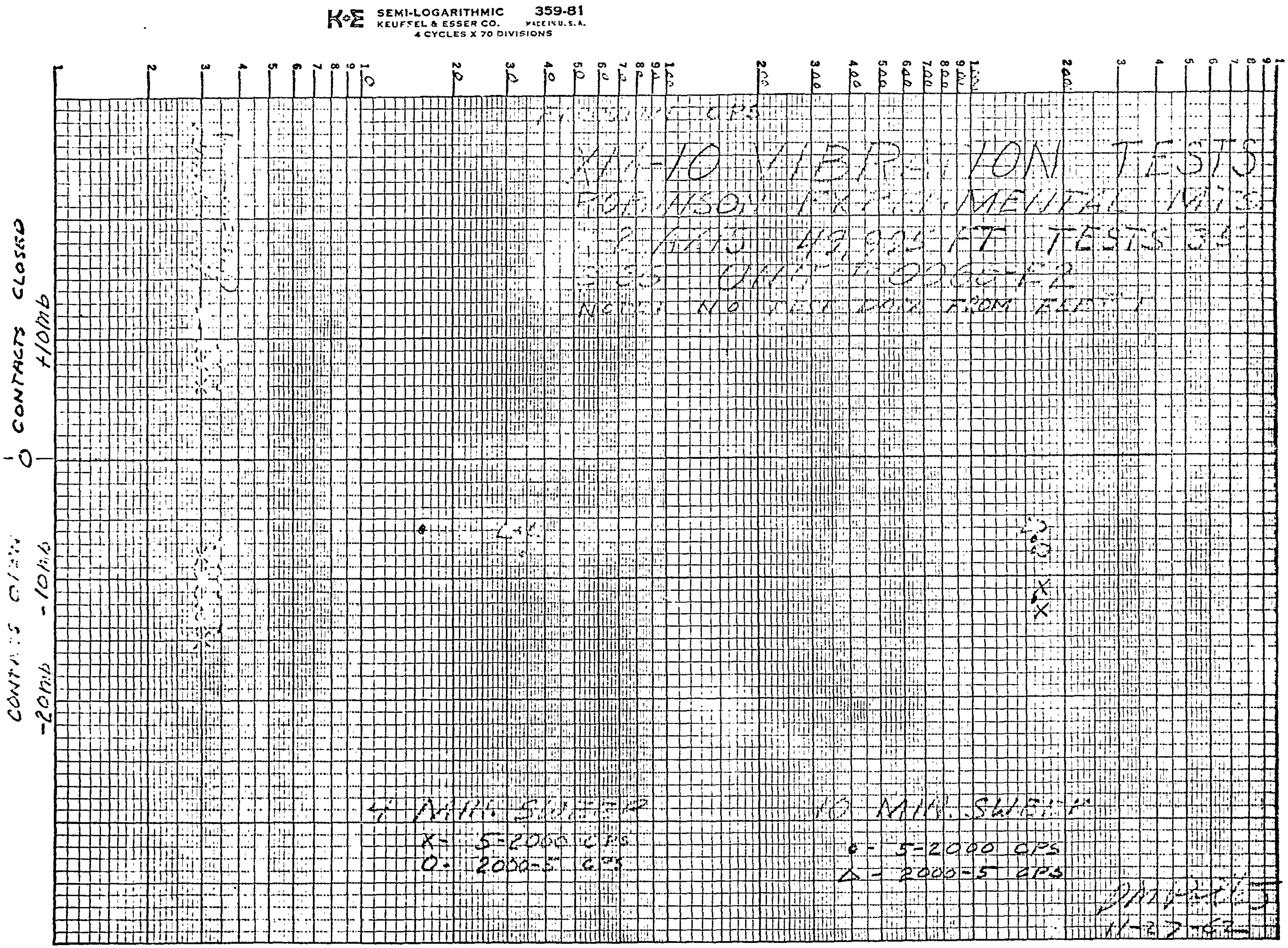
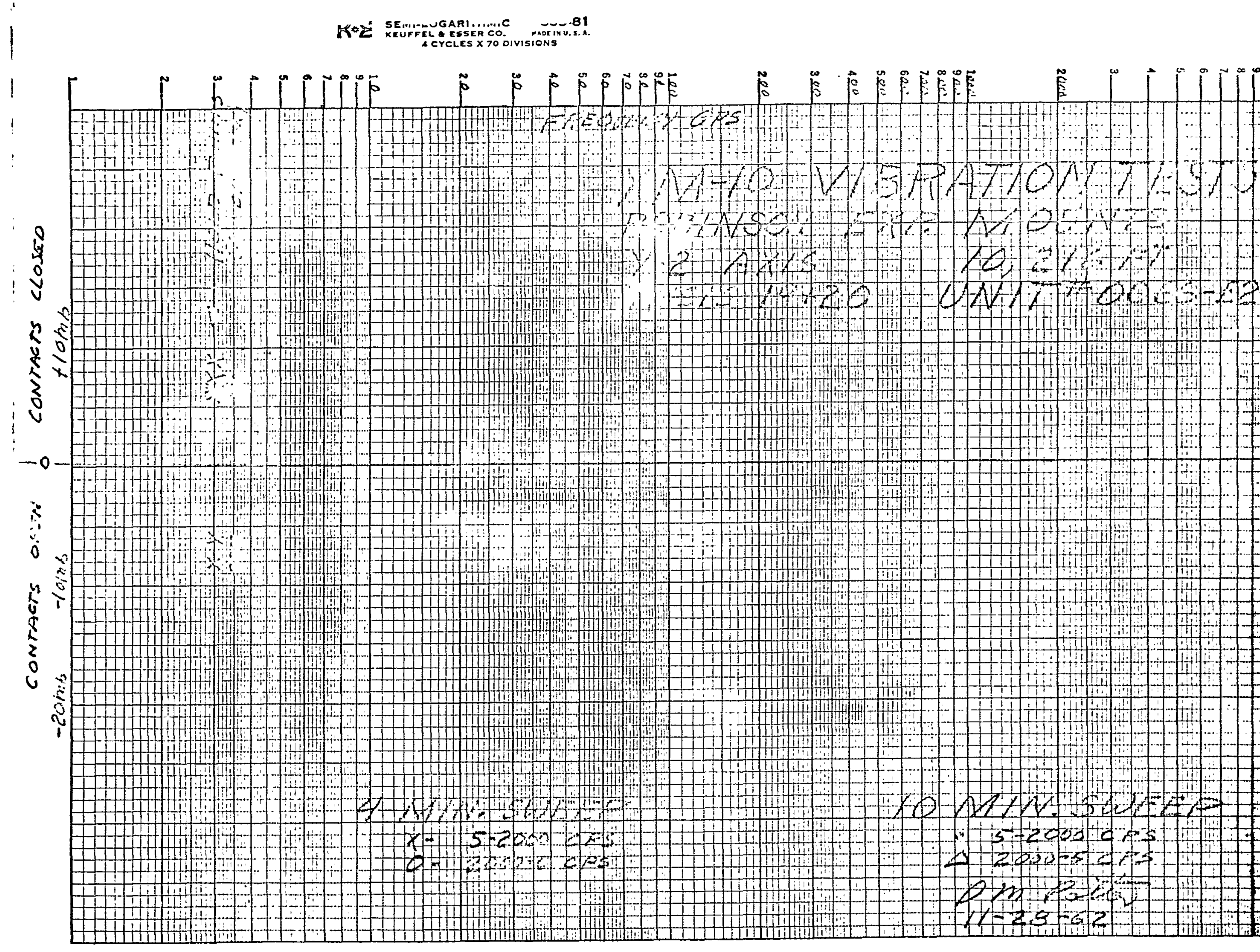
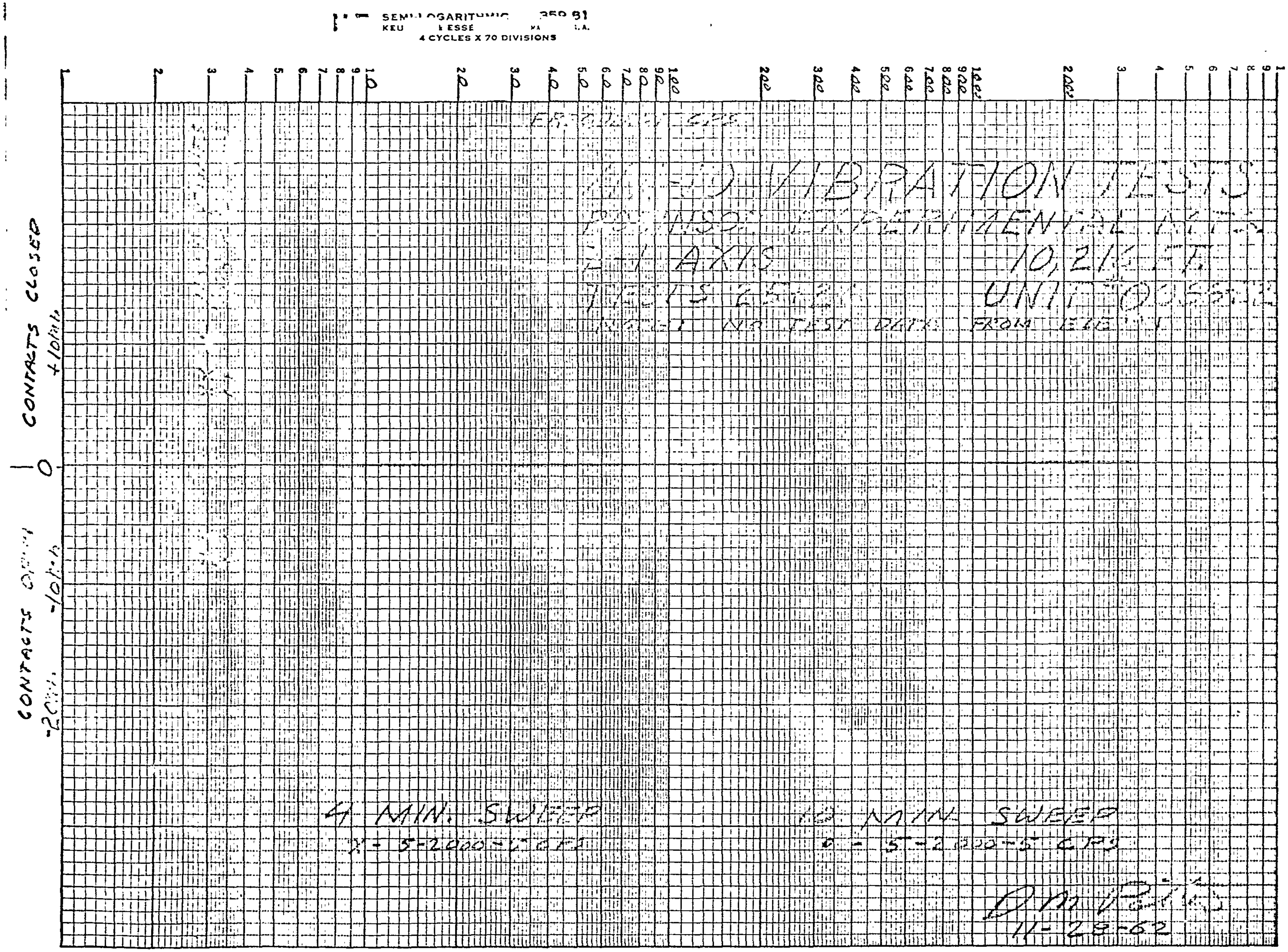
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
FREQUENCY CPS
VIBRATION TESTS
CONTACTS CLOSED +10mb
0
CONTACTS OPEN -10mb -20mb
4 MIN. SWEEP
X - 5-2000 CPS
O - 2000-5 CPS
10 MIN. SWEEP
◦ - 5-2000 CPS
Δ - 2000-5 CPS


SEMI-LOGARITHMIC 359-81
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
TESTS
FROM
CONTACTS CLOSED
+10mb
0
-10mb
-20mb
X- 5-2000 CPS
O- 2000-5 CPS
10 MIN. SWEEP
• - 5-2000 CPS
Δ - 2000-5 CPS


KEUFFEL & ESSER CO.
MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
VIBRATION TEST
AXIS
UNIT
CONTACTS CLOSED
+10mb
0
-10mb
-20mb
4 MIN. SWEEP
X- 5-2000 CPS
10 MIN. SWEEP
5-2000 CPS
2000-5 CPS
11-28-62

K&E SEMI-LOGARITHMIC ...-31
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS

SEMI-LOGARITHMIC 359-91
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS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VIBRATION TESTS
AXIS
UNIT
NO TEST DATA FROM
4 MIN. SWEEP
MIN. SWEEP
CONTACTS CLOSED
+10MA
0
CONTACTS
11-29-62

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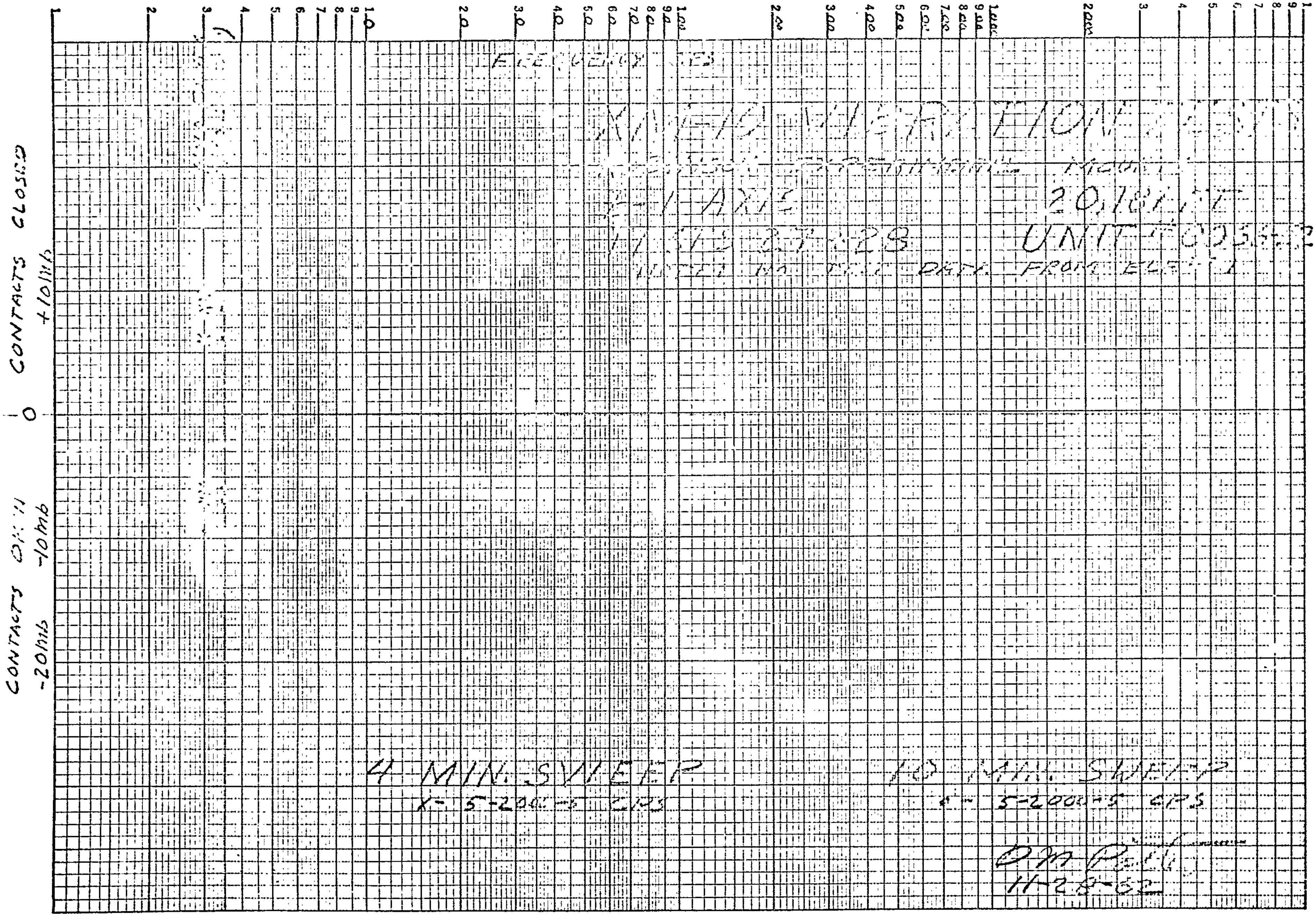
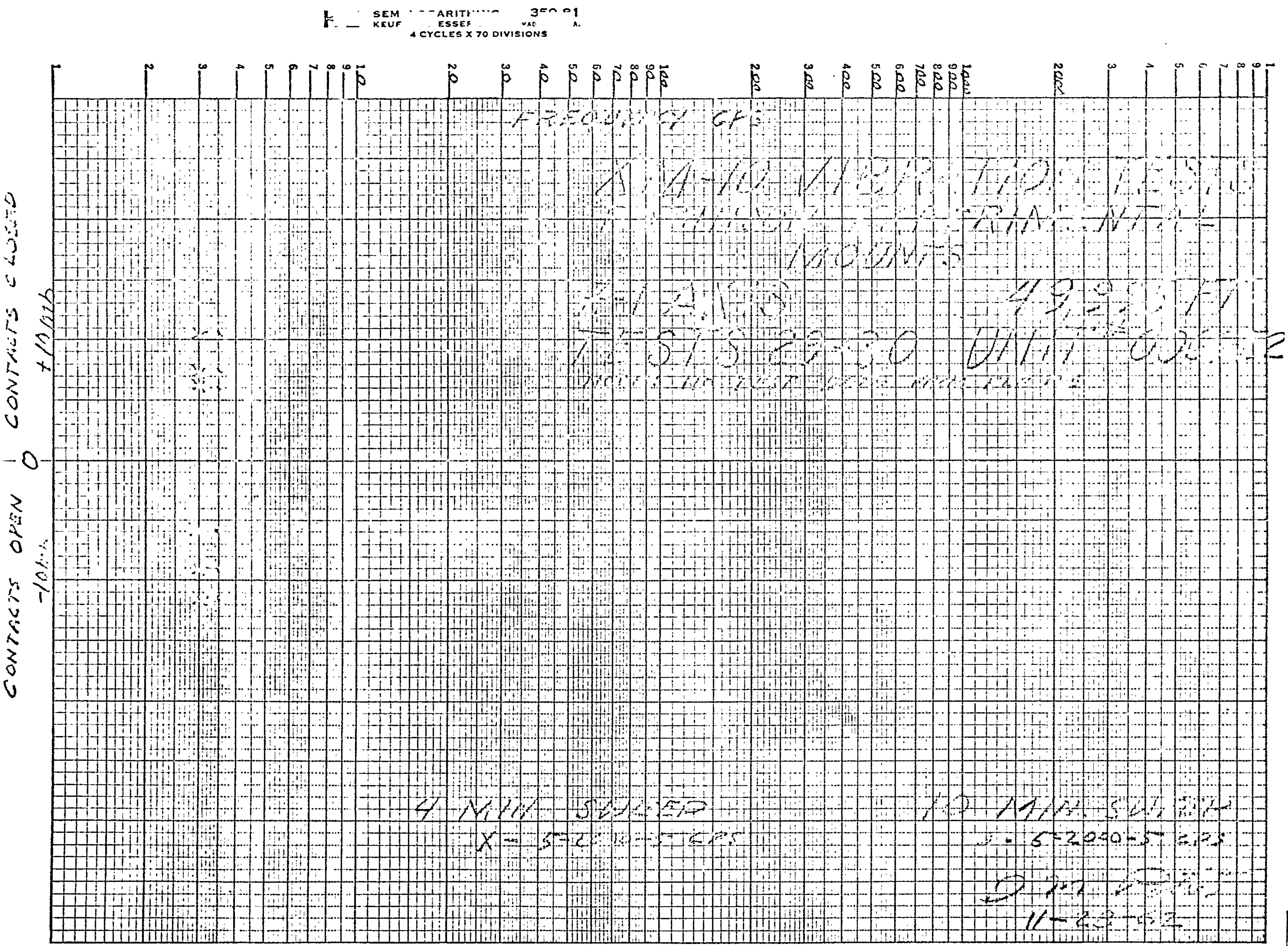
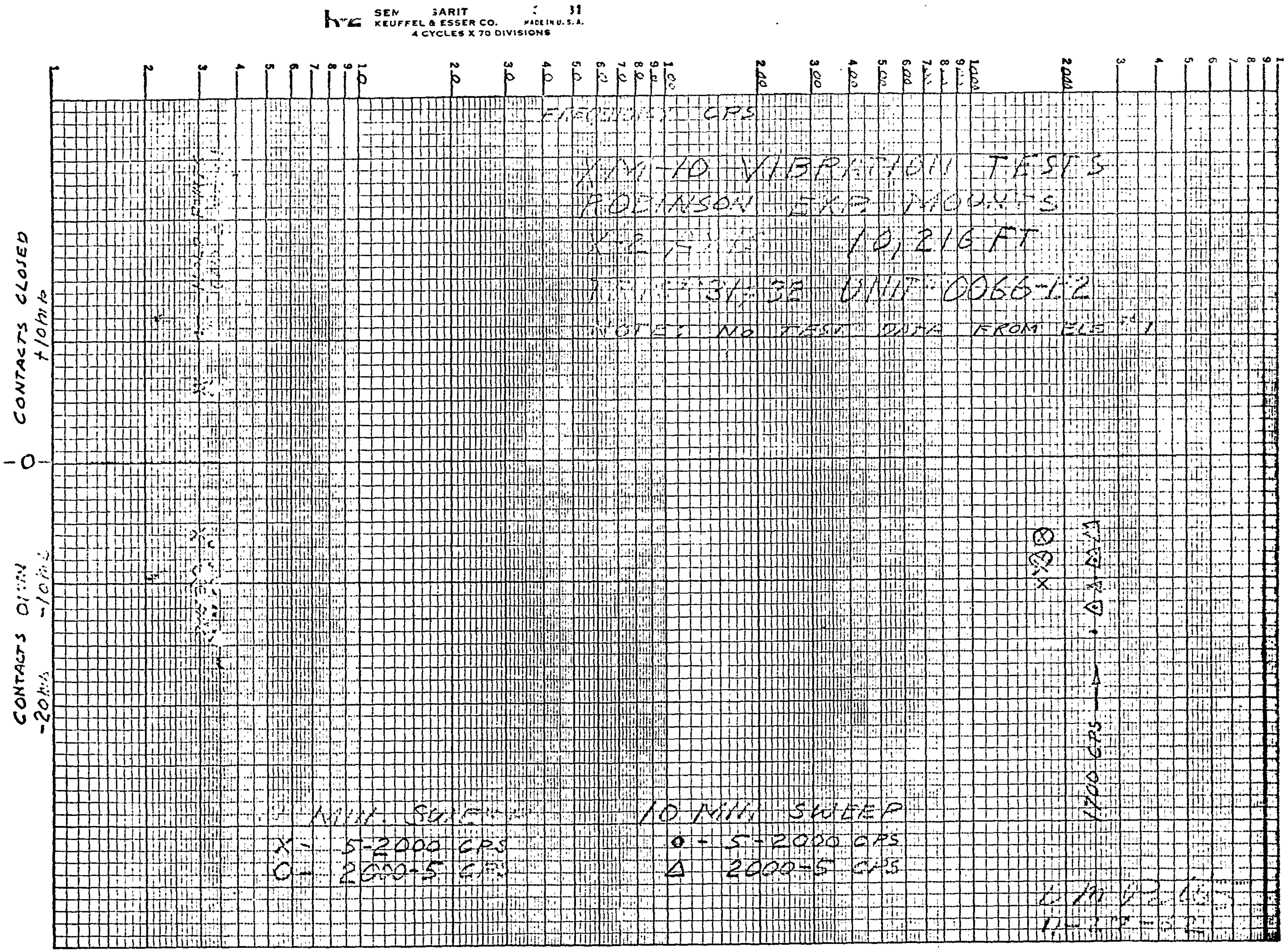
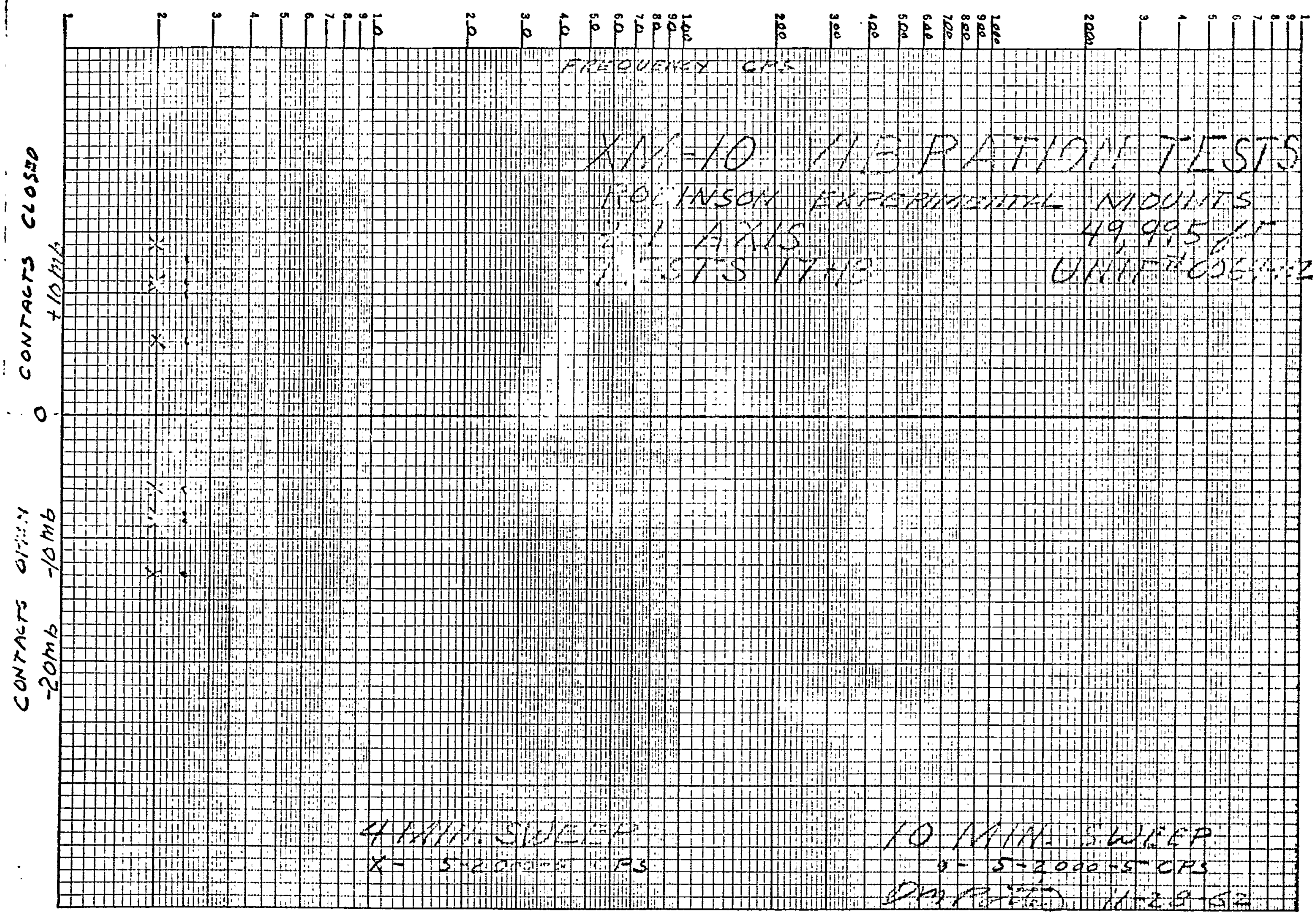



4 CYCLES X 70 DIVISIONS
FREQUENCY CPS
MOUNTS
TESTS 29-30 UNIT
CONTACTS CLOSED
CONTACTS OPEN
0
4 MIN SWEEP
10 MIN. SWEEP
11-22-52


KEUFFEL & ESSER CO.
MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
CPS
XM-10 VIBRATION TESTS
ROBINSON EXP MOUNTS
10,216 FT
UNIT 0066-12
NO TEST DATA FROM
10 MIN. SWEEP
X - 5-2000 CPS
O - 2000-5 CPS
• - 5-2000 CPS
Δ 2000-5 CPS
1700 CPS
CONTACTS CLOSED
+10MA
0
CONTACTS OPEN
-10MA
-20MA

K&E SEMI-LOGARITHMIC 359-81
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS



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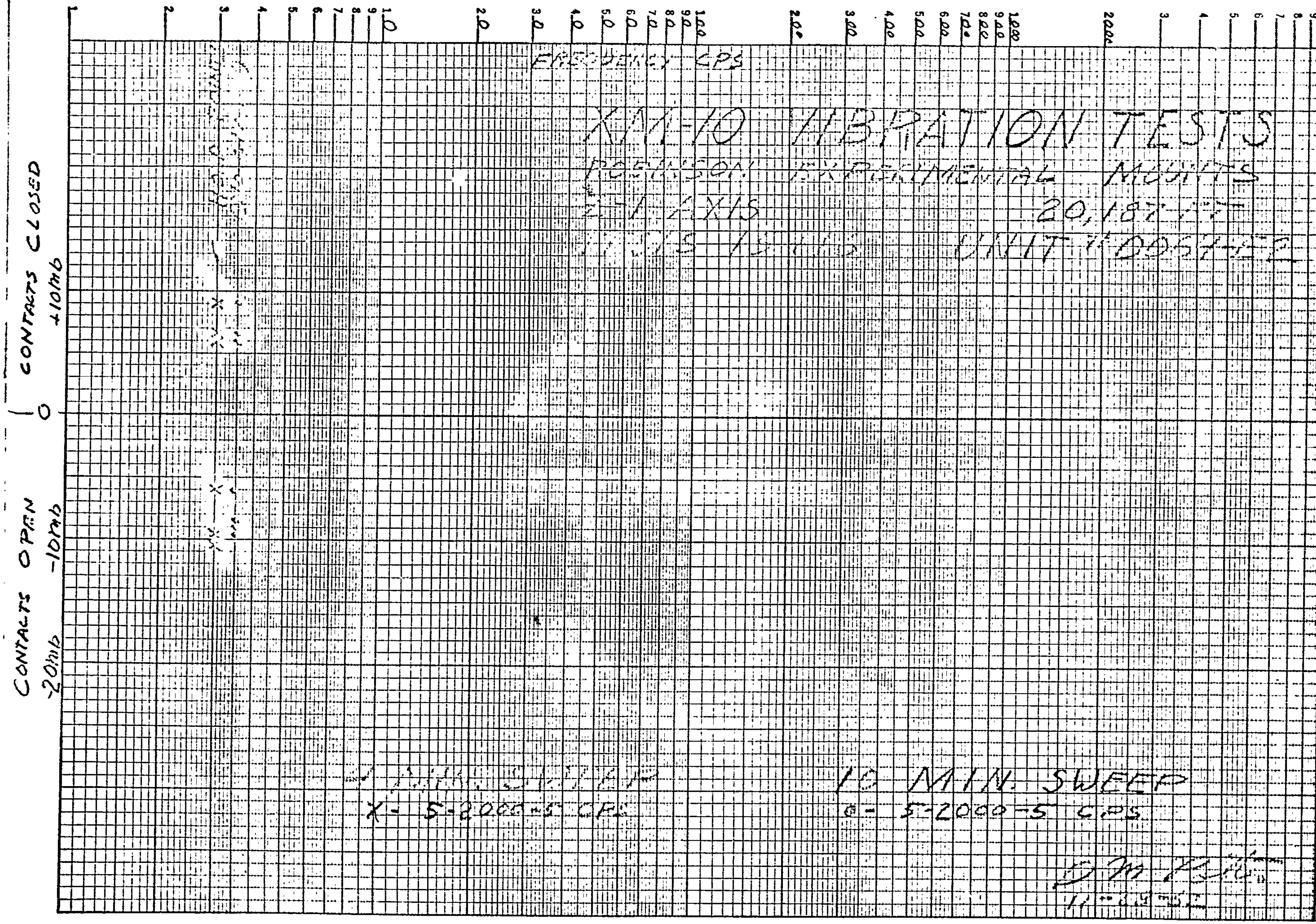
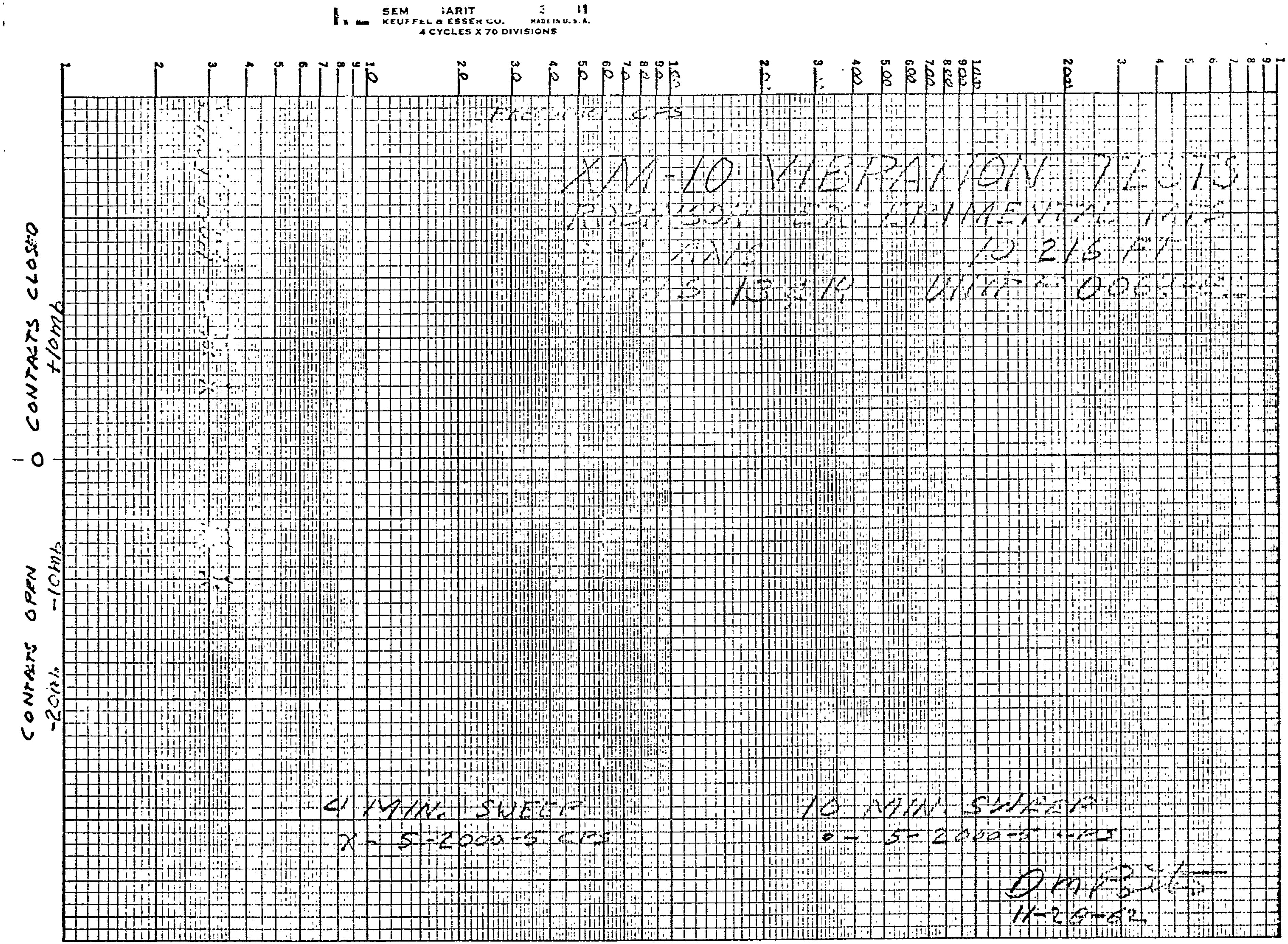
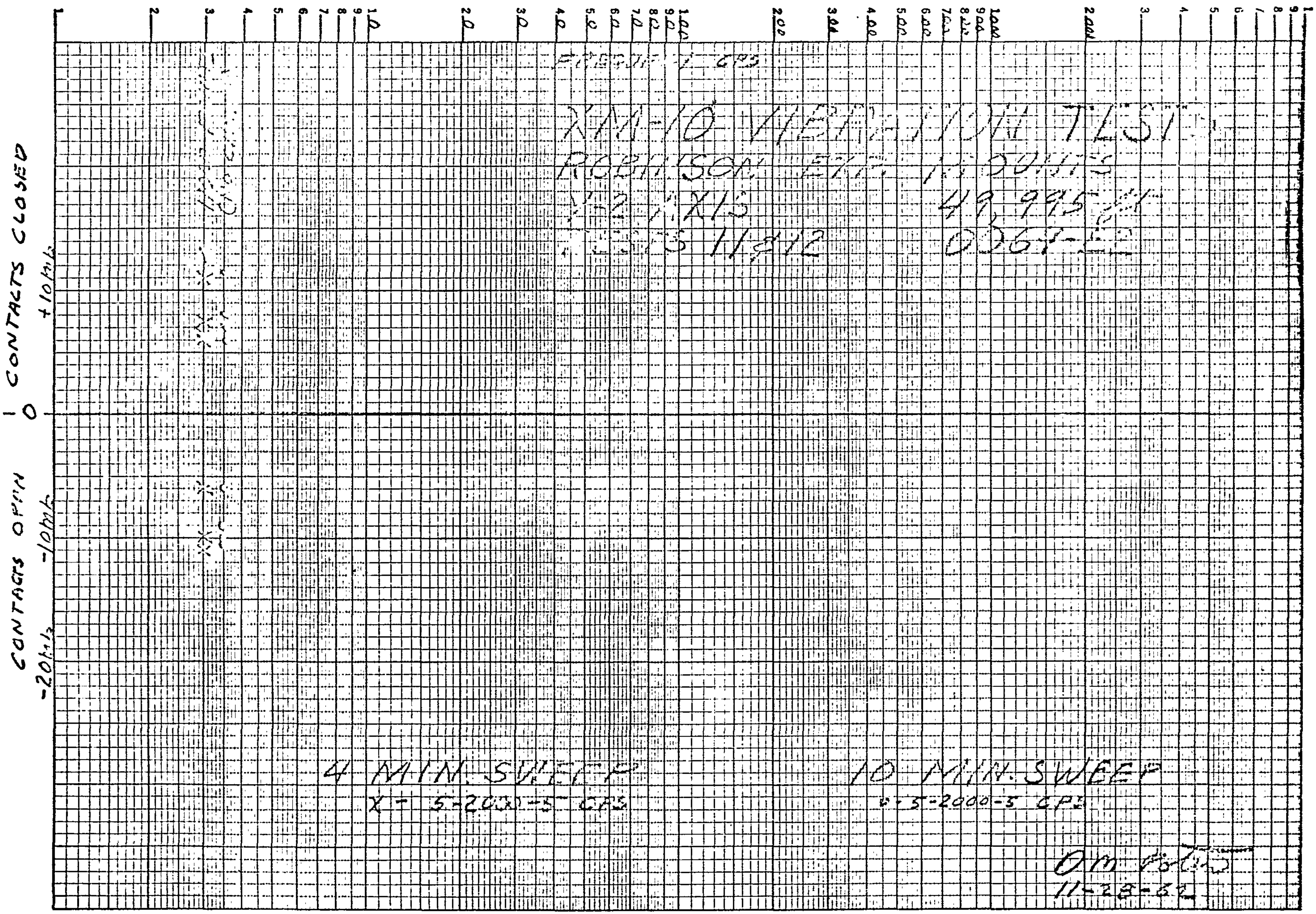
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS

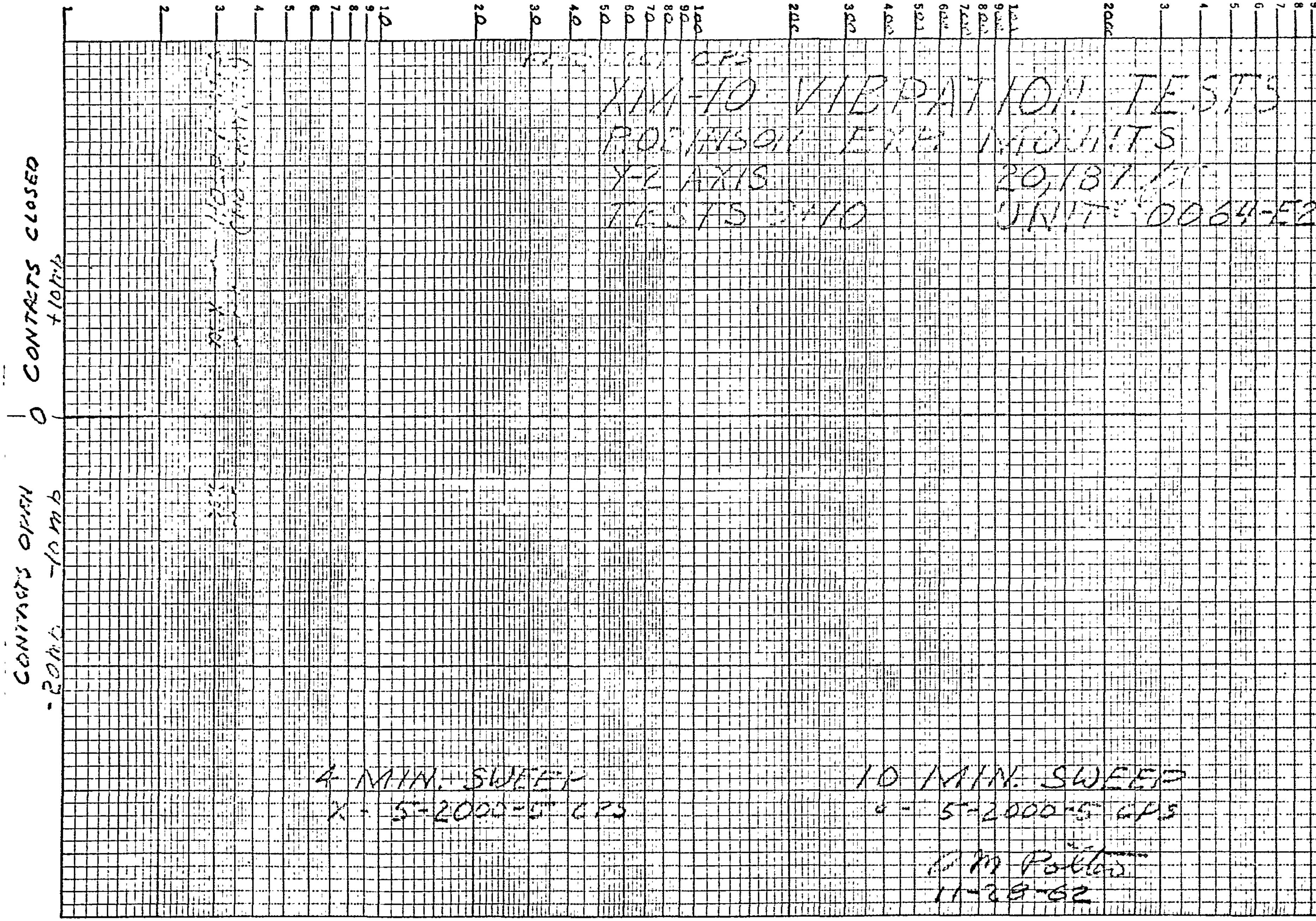


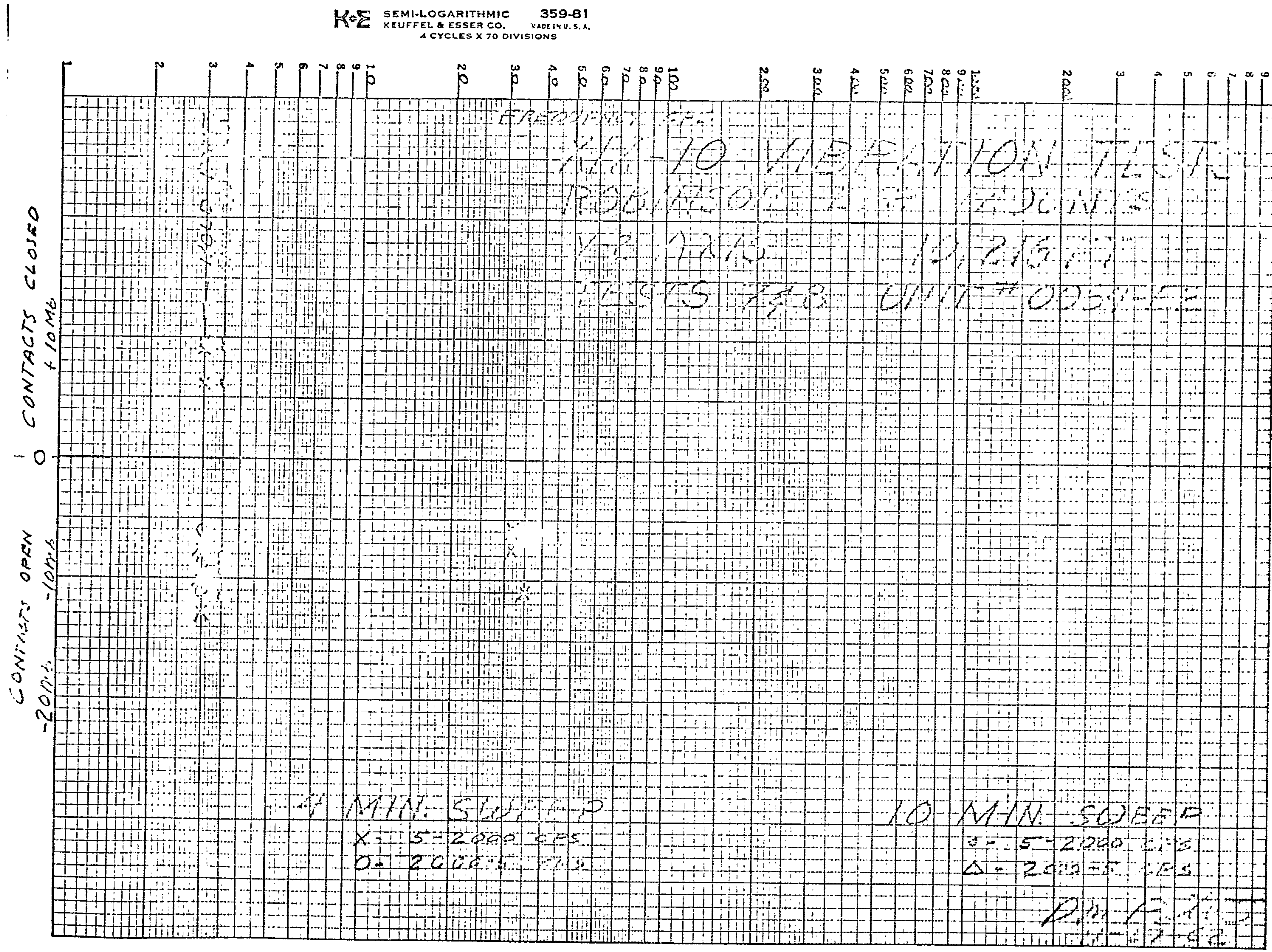

SEMI-LOGARITHMIC
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
XM-10 VIBRATION TESTS
216
CONTACTS CLOSED +10mb
0
CONTACTS OPEN -10mb -20mb
4 MIN. SWEEP
X - 5-2000-5 CPS
10 MIN. SWEEP
5-2000-5
11-20-62

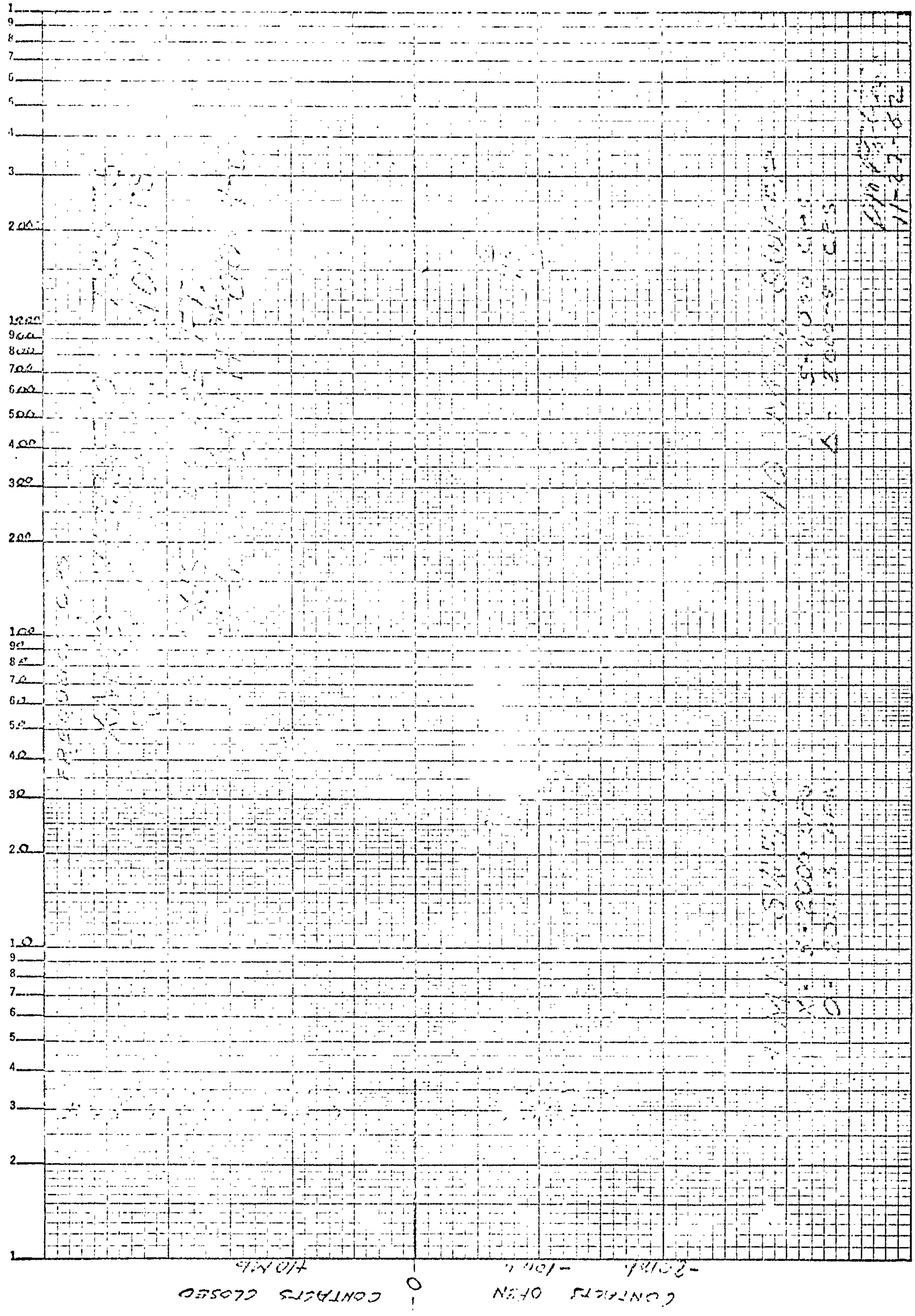
K&E SEMI-LOGARITHMIC 359-81
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS



K&E SEM. ---ARITI 3 1
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS




K&E SEMI-LOGARITHMIC 359-81
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS
VIBRATION TEST
CONTACTS CLOSED
+10MA
0
CONTACTS OPEN
-10MA
-20MA
MIN. SWEEP
X - 5-2000 CPS
10 MIN. SWEEP
△ - 2000-5 CPS


CONTACTS CLOSED
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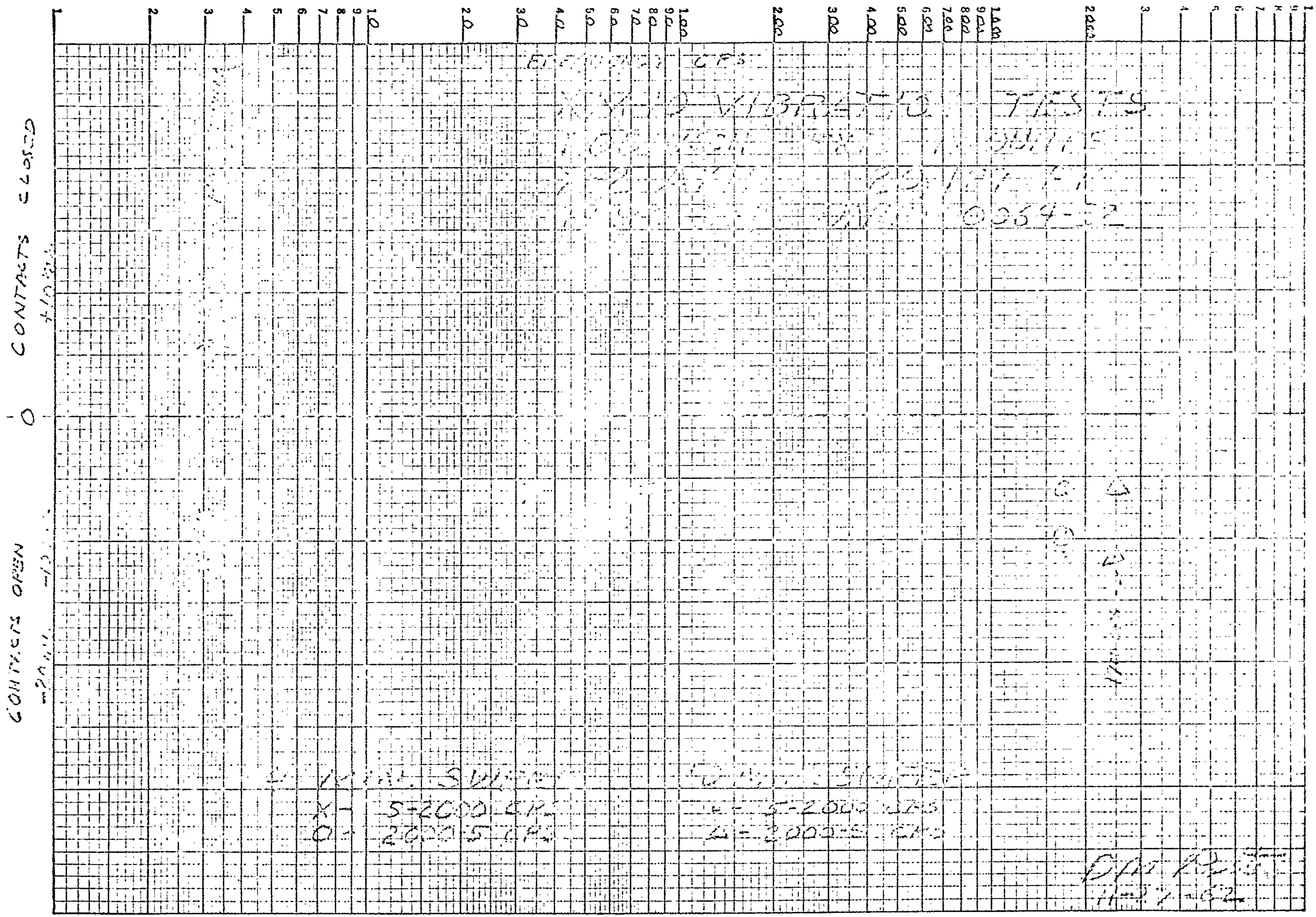
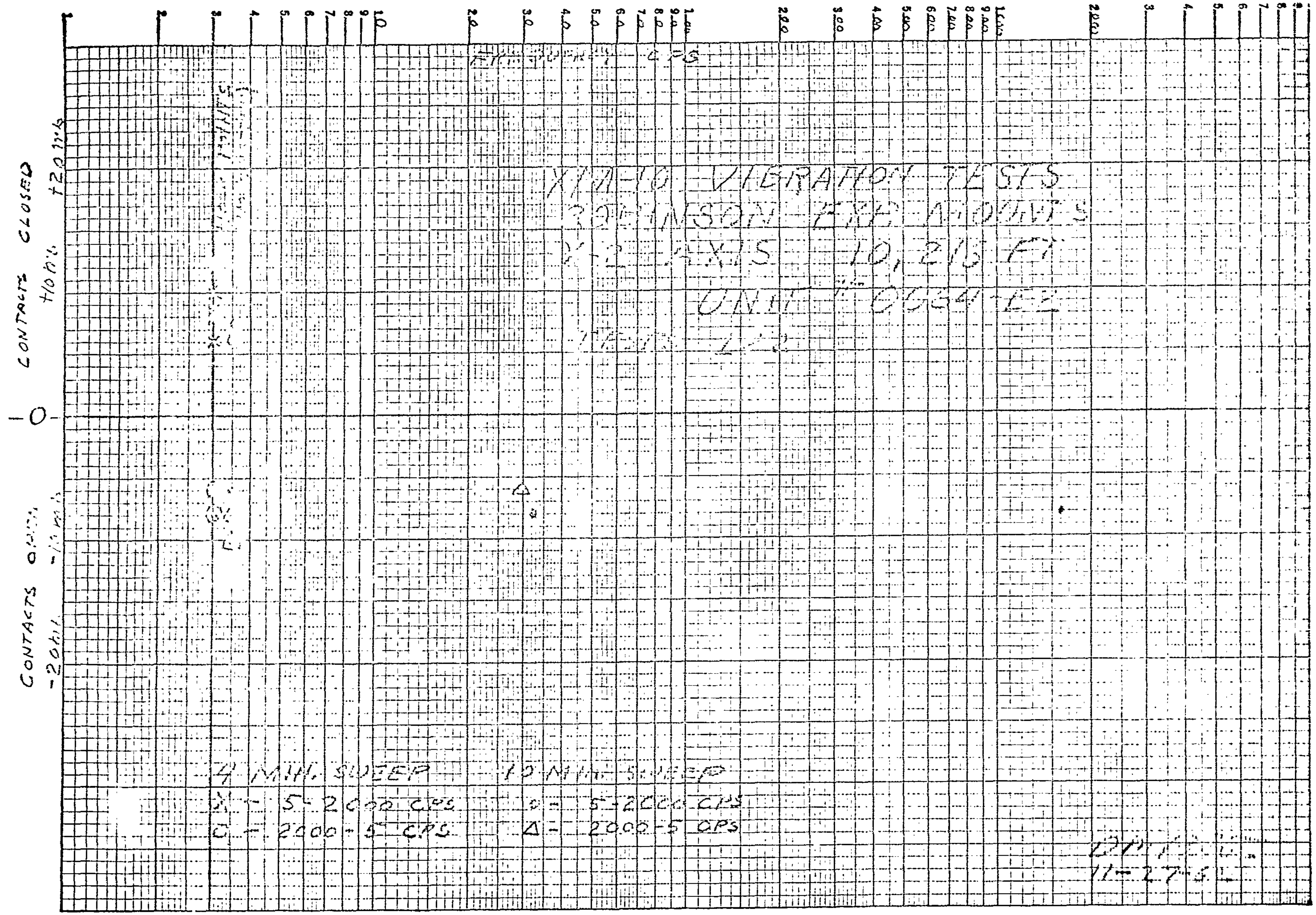
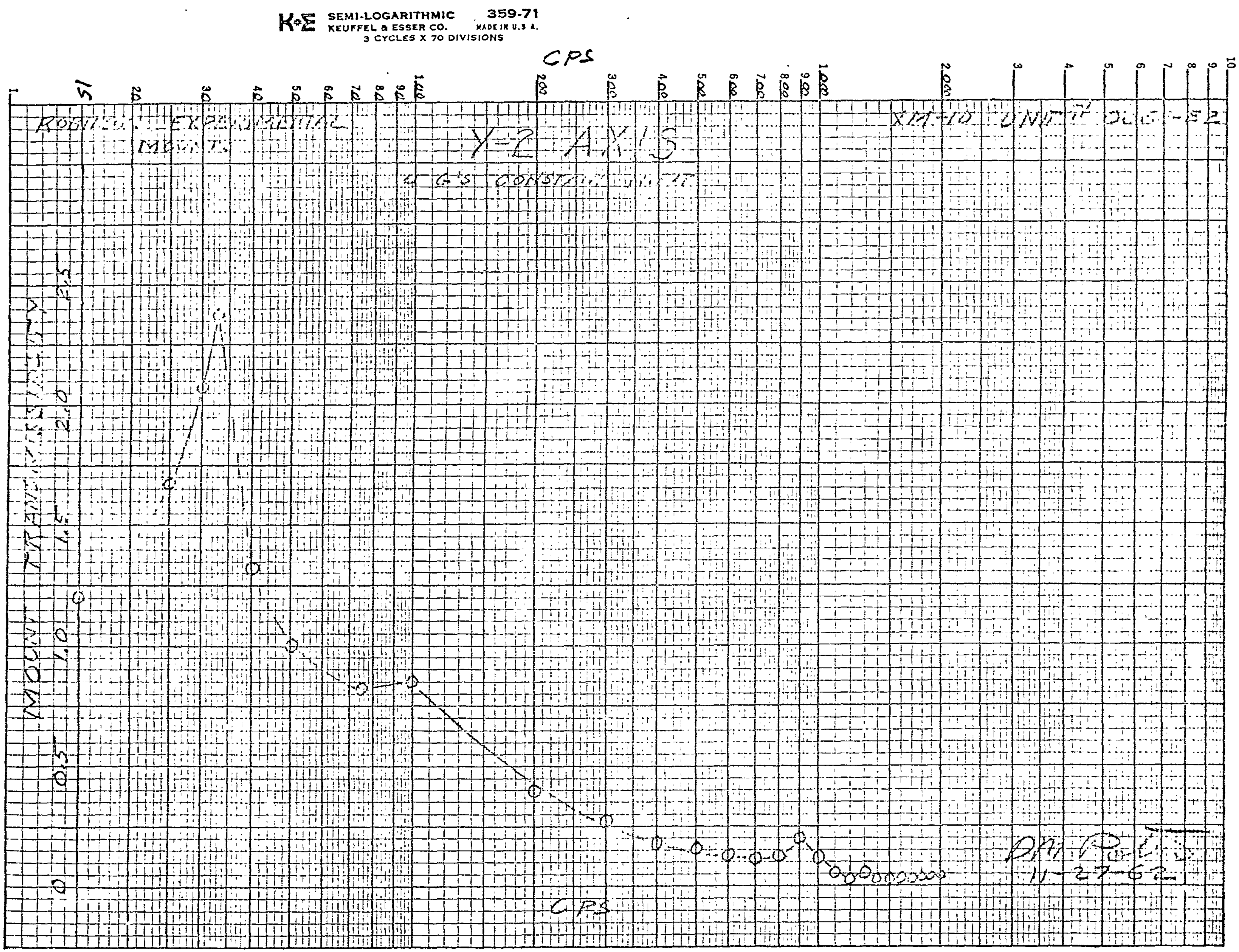
CONTACTS OPEN

SEMI-LOGARITHMIC 359-91
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS



K+E SEMI-LOGARITHMIC 359-81
KEUFFEL & ESSER CO. MADE IN U.S.A.
4 CYCLES X 70 DIVISIONS




K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
CPS
Y-2 AXIS
MOUNT TRANSMISSION
CPS

K&E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS